and District Light Railways Order.

main switch is first closed and then the resistances cut out. On opening the

THE

ELECTRICAL REVIEW.

VOL. XLVI. JUNE 1, 1900. No. 1,175.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

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THE ELECTRIC POWER SUPPLY BILLS.

SIR JAMES KITSON, after the Committee had consulted in private, said that they had arrived at the following opinion:—"That the value of electrical energy as a means for the transmission and application of power has been amply demonstrated, and its importance to the industries of this country is admitted. The Committee accordingly advise that it is of public advantage to facilitate measures which may ensure a general supply of electrical power to all consumers who may seek to avail themselves of the economy and efficiency offered in the service of these sources of application of power."

The importance of the foregoing paragraph was mentioned in a "Note" in our last issue. At the close of the consideration of the Durham and Tyneside Bills, the Committee, to whom all the electric power supply Bills have been referred, declined to give any decision on any one Bill until they had heard the evidence and arguments upon the whole group—and emphasised this decision with the remarkable opinion to which we have already alluded.

Howsoever this *obiter dictum* may disappoint the many opponents to measures relating to the supply of electricity which are now before Parliament, it must be hailed with satisfaction by the electrical world. Armed with the necessary Parliamentary authority vast companies can be floated to supply a cheap and economical source of power over large areas. By this means industries may be promoted in districts where hitherto, owing to the absence of water or other motive power, or the difficulty of obtaining coal, no industrial progress has been made. Each cottage might even have its small motor-driven workshop. Other consequences may follow in the near future. As we have already pointed out in these columns (May 4th, 1900, *sub. tit.* "Electric Power Transmission"), the idea of distributing energy over large areas by means of electricity generated at the pit's mouth, suggested by Mr. B. H. Thwaite in 1892, has now come within the range of practical politics, and we can only hope that the prophecy contained in a paper read by Prof. Forbes at the end of April before the Institution of Electrical Engineers may turn out to be true.

In the ELECTRICAL REVIEW for April 27th, p. 682, we published an article entitled "Electric Motive Power for 'Cottage' Industries." We there pointed out that the Ungarische Allgemeine Electricitäts Gesellschaft and the Budapester Allgemeine Electricitäts Gesellschaft were about to erect a workshop in the neighbourhood of their central generating station, by means of which those engaged in any trade which requires only a small amount of power could obtain it at a very small cost. Might not the same scheme be adopted in this country? Again, in our issue for September 8th, 1899, we pointed out the extraordinary effect of the cheap supply of electricity for driving purposes in the district of St. Etienne. In that district there are to be found no less than 30,000 looms for weaving ribbon, 15,000 of which are in St. Etienne alone.

D

pipe arranged below the bottom level of each vessel and to the corresponding vessel. After being acted upon therein by the water for a time, the valve is

the electro-magnet and having segmental faces and anti-friction rollers. 2 claims.

Of these a fair percentage are now driven by electric power, transmitted from the generating station of an enterprising company, situated about eight or nine miles from St. Etienne. The total power of the plant employed by the company at its various generating stations now amounts to 2,000 H.P.

In addition to the many arguments which have been, and may be advanced in favour of the supply of electricity for minor industries, there is one which we should like to place on record. The tendency of recent years has been for manufacturers and artisans, whose savings have made them capitalists on a small scale, to engage in enterprise on the co-operation system—to sink their capital in limited liability companies, and await the result. While it would be impossible to deny that many beneficial results accrue from such united action, which alone is capable of furnishing the capital for undertakings on a large scale, it may be suggested, on the other hand, that individual enterprise and energy tend to become lost in the office of a great company or syndicate. The up-to-date member of a board of directors must inevitably be hampered by the less energetic of his compeers; while that which may suggest itself to an intelligent board of directors, may well fail to meet with the approval of the majority of shareholders assembled at an extraordinary meeting. Any measures which will tend to bring each man a little nearer to being his own master—if he wishes to be his own master—cannot fail, in our humble judgment, to have a beneficial effect.

The Institution of Electrical Engineers.

One or two interesting announcements were made at the annual meeting of the Institution of Electrical Engineers on the 24th ult. The Museum Committee appointed some time ago is about to issue a circular to members and other persons calling attention to the intention of the Institution to make an historical collection of electrical apparatus, specimens of submarine cables, telegraph apparatus and other appliances. It is intended to invite those in whose possession historical apparatus may be to afford the Institution facilities for cataloguing them, so that in the event of such apparatus coming on the market they may be sought after and obtained for the Museum. Others again may prefer the safety of the Museum, and entrust important relics to the care of the Institution. The members present at the meeting—poorly attended as it was—appreciated the progressive character of the report presented by the Council, particularly in its references to the absorption of the Northern Society of Electrical Engineers and the formation of local sections. The amusing hits of the meeting, which enlivened the more or less academic discussion of the balance sheet and accounts, were contributed by Mr. Raworth, who referred to the vanity of members in desiring to possess vellum diplomas, with the good result thereof that £48 profit on the vellum diplomas issued so far was transferred to the building fund. The President reminded those present that in the very room then used, at the Society of Arts, for the meeting, Sturgeon in 1825 first exhibited a soft iron electro-magnet. Mr. Swinton had calculated that in a recent electrical case at the Law Courts the lawyer's fees ran up to about £5 per minute; we agree with him that the Institution is well served, considering that it manages to gets its legal work done for nothing. Altogether it will be found that the report, when published, discloses a most satisfactory and progressive state of affairs.

Technical Education at the University of Illinois, U.S.A.—The equipment of the mechanical and electrical engineering laboratories at the University of Illinois, in the United States, is certainly on a better and by far more complete scale than anything that has been attempted here. The mechanical laboratory contains six steam engines of various types, three gas and gasoline engines, five steam pumps, an air compressor, four boilers of three different types, each fired by a different system of mechanical stoker, an injector testing plant, besides the usual laboratory apparatus and machinery. The various power plants in the town are also available for outside testing work, and in each year trials are carried out on the plants in adjacent cities. A significant and valuable feature in the electrical engineering course is the recognition accorded to the growing specialisation in this branch of engineering. After the first 2½ years of the undergraduate course, the work is divided into three groups: (1) General electrical engineering; (2) Electro-physical course; (3) Electro-chemical course. Direct current and alternate current work is carried on in a room 46 feet wide × 146 feet long × 16 feet high. Special transformers are provided for all kinds of tests in polyphase work, and photometry receives due consideration. The University is lighted throughout by electricity, and the lighting and power plant is specially designed for testing.

Australian Electrical Schemes. — Major Cardew appears to have been very busy during his stay in Australia. He went out to advise the Sydney Town Council on the subject of electric lighting, and his scheme has been approved. A resolution has been passed appointing Messrs. Preece & Cardew consultants to carry the scheme through at a cost of £150,000. Major Cardew was also asked, while out there, to prepare a scheme for the Redfern Council, and this came up for consideration in March. We have not yet heard the result. The Major then left for Melbourne, also to report on the subject of electric lighting. It has been suggested to us that this information may give rise to serious trouble by leading to a general exodus of consulting engineers from this side, where they are rapidly becoming so few and far between. Our own apprehensions on this score are not very serious.

The Effect of the Ottawa Fire on Electrical Works.—The *Canadian Electrical News* for May says that the electrical companies in Ottawa suffered heavy loss by the recent fire which commenced in Hull, and which destroyed the major portion of the city of Hull and nearly 2,000 buildings in Ottawa. The fire totally destroyed the street railway power house and contents, but the new 1,200-KW. generator direct connected to six Stillwell-Bierce horizontal turbines, which was installed recently in a new power house, was saved owing to its being built largely underground. The Ottawa Electric Company (the lighting company) being the result of the amalgamation of three former electric lighting companies, had six power houses, namely, one central distributing station and five sub-stations, one of which was a steam station, and another was devoted to an arc light exclusively. Four of these sub-stations, including the arc light station, were totally destroyed, even the walls of the buildings being useless. The company was left with its central station and steam auxiliary. While the arc light station was burning negotiations were going on for machinery for temporary use. Letters of sympathy were received from the principal electric lighting companies in Canada, and valuable services were rendered by the Royal Electric Light Company, of Montreal, and the Toronto Electric Light Company. When our contemporary wrote the company was engaged in setting up, in a building owned by Mr. J. R. Booth where some water wheels were available, a temporary sub-station which will enable it to carry on its ordinary service while a new plant is being installed. The company was supplying nearly all its incandescent service and motor service. Three days after the fire 150 street lamps were going, and it was expected that by May 10th all the street lights would be on. The Street Railway Company did not stop running, although the service was limited to some extent for a few days. They are now running full blast. It is the intention of the Ottawa Electric Company to erect a new and strictly up-to-date plant.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

BY HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from Vol. 45, page 426.*)

SWITCHBOARDS.

THE details of switchboards vary to a considerable extent in accordance with the type of winding of the generators, *i.e.*, whether they are shunt or compound wound or collectively or separately excited, and with the presence or absence of accumulators; while to a minor extent these details also vary in accordance with the use of the two and three-wire system of feeders respectively. Where small generators and few feeders have to be dealt with, their connections are carried on the same board, but where the feeders are many and the generators large, the switchboard is divided into distinct portions called the main and feeder boards. The most approved practice is to make up a switchboard from standard panels, each complete in itself, *i.e.*, containing all instruments, switches, and connections required for working it. These panels are supported by vertical angle irons, and by bolting them side by side a continuous switchboard is formed.

Where the main and feeder panels are not distinct, each contains all the adjuncts required for working a given size of generator with its share of the feeder system, and the general board is made up of a series of what may be termed identical compound panels; but where the panels are distinct then the main board consists of a series of identical simple panels, each containing the adjuncts for a given size of generator only, while the feeder board is similarly made up of a corresponding series of simple feeder panels only. In some installations these two boards are united and continuous, but in others they are for the sake of convenience

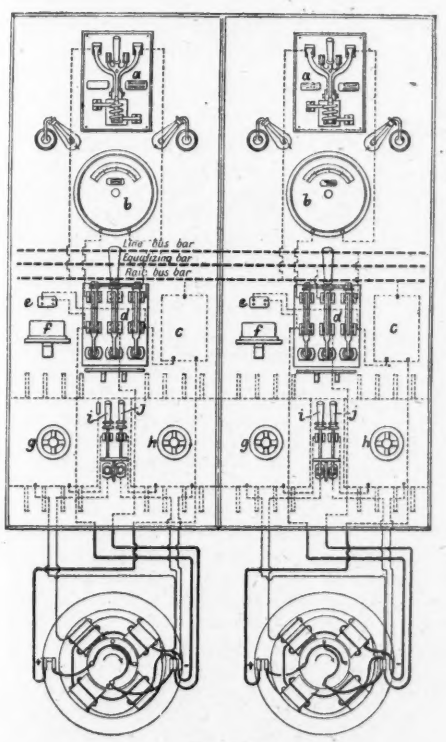


FIG. 96.

kept separate and discontinuous. Whether the two boards are united or separate the practice is to place the main registering and measuring instruments on a panel by themselves, and the equalising switches away from the boards also by themselves close to the generators.

Fig. 96 is a representation of a compound panel, where A is the auto-circuit breaker set to open when the current exceeds a certain strength; B, the ammeter; C, the lightning arrester; D, the main switch, cutting out simultaneously the line, equalising and rail bus bars, from the generators; E, the voltmeter plug; F, the voltmeter bracket; G, a rheostat in series with the shunt field, regulating the brush potential difference; H, a rheostat in parallel with the series field, regulating the over compounding; I and J, the switches, cutting out G and H respectively.

Fig. 97 shows the connections of a board for compound wound generators. In the latter the field switch, A, in the first position places a resistance (of the desired amount) in series with the shunt winding of generator which takes off the extra

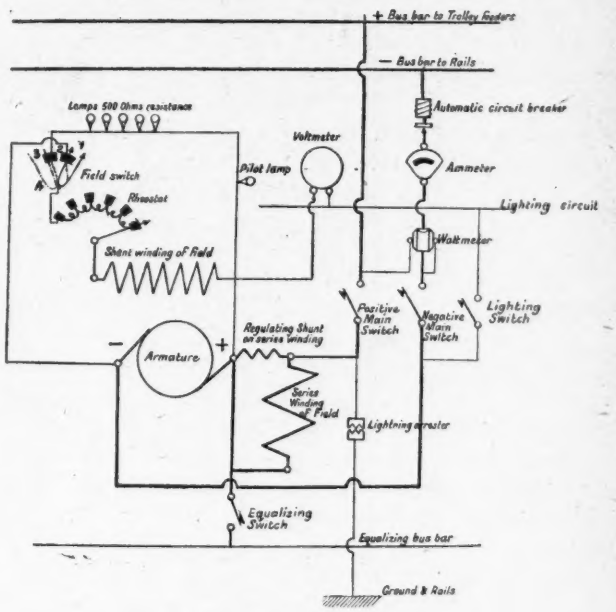


FIG. 97.

current due to self-induction when generator is switched on or off. In the third position a second generator, to be put in parallel with the first, is excited by the main current before being actually in parallel on the circuit. The shunt winding is switched off simultaneously with its generator in every case.

In the three-wire system two generators are connected in series, the middle wire being connected with the rails and the other two to alternate insulated sections as shown.

With the three-wire system, which is better suited to double-track or single-track parallel-line roads, the difficulty is to keep a perfect balance between the sections; this involves special arrangements, and the use of double-throw quick-breaking switches which instantaneously transfer the feeders from positive to negative, or *vice versâ*, to meet the fluctuation of the load. With very light loads all the feeders can be thrown on one side of the circuit and the ordinary two-wire system produced. In other respects the instruments and switches required are identically the same for the two systems.

The use of accumulators as a reserve in electric traction installations is not yet by any means common, though usual in lighting practice. The essence of this system is the introduction of a small auxiliary generator to keep the regulating cells charged, and an automatic switch which cuts the generator, which is always in parallel with the batteries, in and out of the circuit when the tension in the batteries is in excess of, or in defect of, that of the generator respectively. When the load on the line is light the batteries are being charged, and when it is heavy the latter come to the assistance of the generator.

The instruments used on switchboard work comprise circuit breakers, lightning arresters, ammeters, voltmeters, wattmeters, and rheostats. The first of these are at once the most important and the most difficult to construct. A great difficulty of construction is involved by these instruments having to support the heavy sparking and burning of contacts resulting from the arcing formed when heavy currents at high potentials are broken. A circuit breaker has to

and progressive state of affairs.

perform with reference to an electric plant, a function wholly analogous to that performed by a safety valve in a steam plant; it has to so regulate the pressure that it shall not exceed certain safe limits within which the plant has been designed to work. In the case of an electric plant an excess pressure can be removed as instantaneously by breaking the circuit, as would be the case in a boiler were it possible to open a safety valve with an orifice of dimensions large enough to allow the whole of the steam to escape at once. The function of the weights or the coiled spring of the safety

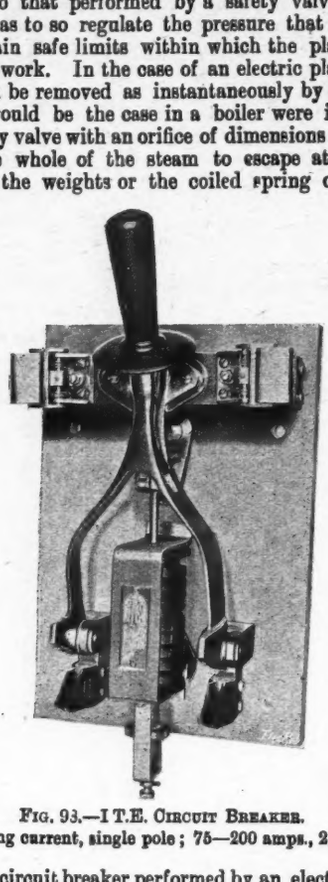


FIG. 98.—I.T.E. CIRCUIT BREAKER.
(Alternating current, single pole; 75—200 amps., 2,500 volts.)

valve is in a circuit breaker performed by an electro-magnetic device which comes into action as the designed limit of pressure in the circuit is approached. A circuit breaker, which is constructed in such a way as to afford the required protection to a circuit, must possess the following characteristics:—

1. The time required to open a circuit by the operation of the circuit breaker must vary directly with the proximity of a short circuit, *i.e.*, the nearer a short circuit approaches, the shorter must be the time required to break the circuit.

2. The breaking of a circuit must be absolutely assured when the designed limits are reached, *i.e.*, the opening of the main switch by the action of the circuit breaker must be certain without any possibility of "floating" within 5 per cent. of the adjustment.

3. The adjustments of the circuit breaker must be constant, and not subject to variation of any kind while in use, *i.e.*, must give a quick reliable wide clear break at all times.

4. The electro-magnet must develop not only the power actually required to release the catch holding the jaws of the main switch together, but additional power to assist in the rapid opening of the same, as well as of the subsidiary contacts which finally interrupt the circuit.

5. The current carrying parts must be of ample carrying capacity, so that the heating of any part in constant use at actual rating shall not exceed 20° C. above the surrounding temperature, and their construction must be thorough so that they are not liable to get out of order.

The I.T.E. ("inverse time element") circuit breaker thoroughly fulfils the whole of the above conditions, and is constructed under various types to suit all classes of work for which they are required. Figs. 98 and 99 show forms adapted for alternating and direct-current circuits respectively. In these instruments the main contact pieces have a constant tendency to fly apart, owing to the pressure of a heavy coiled spring, and are retained in contact by a catch. The electro-magnetic device consists of a solenoid coil connected with an armature supported by light springs. When the pressure in the main current passing through the solenoid reaches the limit for which the device is set, the armature is pulled down against the pressure of the supporting spring and the catch keeping the main contact fast is tripped and the latter flies open, the opening being assisted by the remainder of the energy developed by the descending armature. The main contact is supplemented by subsidiary contacts between copper

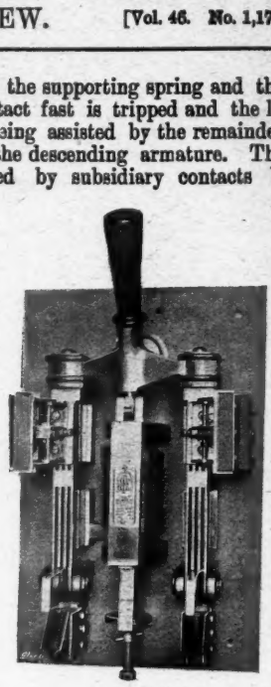


FIG. 99.—I.T.E. CIRCUIT BREAKER.
(Standard switchboard D.P. type, 300—600 amps., 550 volts.)

springs and carbon rods which come into action on the main contact opening and finally break the circuit. The main contacts are laminated knife-edge contacts which are multiplied numerically in accordance with the rating of the breaker.

(To be continued.)

HOMES FOR DISCHARGED SOLDIERS.

Building Trades' Gift to the Nation; Electrical Section.

IN our issue of February 2nd we gave a brief account of the movement organised by an influential Committee of architects and representatives of the building trade to provide Homes of Rest for discharged soldiers. The Homes are now being erected at Bisley on ground presented for the purpose by Lord Pirbright, the materials, or their money equivalent, being given by various firms connected with the trade, and the cost of erection being covered by subscriptions to which not only employers but also large numbers of workmen are contributing according to their means.

About £16,500 has already been subscribed in kind, and there is also, we are informed, about £2,500 in cash at the bank to the credit of the fund. When completed the Homes will be made over to the nation. The arrangements for their maintenance have been undertaken by the Soldiers' and Sailors' Help Society, which is under the patronage of Her Majesty the Queen, and which has the necessary administrative machinery already in existence, under the guidance of H.R.H. Princess Christian and a strong Homes Sub-Committee.

There has been formed to make the arrangements for the electrical installation a committee consisting of the following gentlemen:—Messrs. M. Byng, A. Collins, H. Edmunds, R. K. Gray, R. Wallis-Jones, A. B. W. Kennedy, F.R.S., J. E. Kingsbury, W. L. Madgen, E. Manville, Sir W. H. Preece, K.C.B., F.R.S., and Mr. R. P. Sellon, with Prof. Perry, F.R.S. (President I.E.E.), as chairman, Messrs. Alabaster, Gatehouse & Co. as hon. treasurers, and Mr. W. G. McMillan (Secretary I.E.E., 28, Victoria Street, S.W.) as hon. secretary. Mr. Adrian Collins has given his assistance by drawing up the specifications for the generating plant, wiring and fittings, and for any arrangements that may be found to be desirable for the supply of electric power in the laundry, workshops, or elsewhere. As soon as this specification is ready the Committee hope to appeal to the electrical trade for gifts, either in money or

the auto-circuit breaker set to open when the current exceeds

at high potentials are broken. A circuit breaker has to

E

in kind, to enable them to equip the Homes satisfactorily, and they are hopeful that the contributions will not only suffice for this purpose, but will provide a substantial surplus that may be handed over to the Princess Christian's fund for the maintenance of the Homes. Already very satisfactory progress has been made, as has been notified from time to time in our columns.

Although no special inducements can be necessary to support so good a cause, it may be mentioned that the electrical trade will benefit by the establishment of the Homes, inasmuch as it has been arranged that "a discharged soldier who can show that he has for some years been working in the building or allied trades prior to service with the colours, or has been connected with these trades whilst a reservist, will have precedence when a selection has to be made for a place in the Homes in question, so that the Homes will always be identified with the interest of the donors." The committee is assured that all branches of the electrical trade will rank with the sections of the building trade already assisting the scheme, in the enjoyment of such special privileges as may be granted to the building trades in connection with the Homes forming the gift.

THE GENERATING PLANT AT THE PARIS EXHIBITION.

THIRTY-EIGHT generating sets will supply energy for light and power to the grounds and buildings of the Exhibition. Half of these are in the French and half in the Foreign Sections.

For the following details we are indebted to *L'Electricité à l'Exposition de 1900.*

Table I. gives the outputs, &c., of the various generating sets in the French Section, and Table II. gives the same information for the Foreign Section. From these it will be seen that the total output is 20,245 KW. (necessitating a total of 36,155 I.H.P. at the engines), divided up as follows:—

Continuous current	20 sets giving	8,260 KW.
Single-phase alternating current	2 " "	1,270 "
Two " " "	1 " "	480 "
Three " " "	17 " "	10,235 "
Total ...		20,245 KW.

The 19 sets in the French Section provide

Continuous current	3,085 KW.
Two-phase alternating current	480 "
Three " " "	4,510 "

whilst the outputs of the 19 sets in the Foreign Section are divided up amongst the various countries as shown in Table III. It is noticeable that the Willans & Robinson

TABLE III.

	Number of sets.	Continuous current. KW.	Alternating single phase. KW.	Three-phase. KW.	Total output in KW.
Germany	4	850	1,020	2,305	4,175
Great Britain ...	3	1,900	"	"	1,900
Austria	2	900	"	510	1,410
Belgium	3	"	"	1,740	1,740
Hungary	1	"	"	670	670
Italy...	2	1,025	"	"	1,025
Holland	1	300	"	"	300
Switzerland ...	3	200	250	500	950
Total ...	19	5,175	1,270	5,725	12,170

TABLE I.—FRENCH SECTION.

—	Maker of engines.	Makers of dynamo machine.	Ind. H.P.	KW.	Nature of current.	Amps.	Volts.	Frequency.
1	Société Alsacienne de Constructions Mécaniques.		1,200	675	continuous	1,400	500	...
2	Crépelle & Garand.	Decauville, Aîne.	1,200	675	"	2,800	250	...
3	Société de Laval.	Maison Bréguet	300	170	"	700	250	...
3	Société de Laval.	Maison Bréguet.	300	170	"	700	250	...
4	Compagnie de Fives-Lille.		1,200	675	triphase	180	2,200	50
5	Piguet & Co.	A. Grammont.	600	340	"	90	2,200	50
6	Garnier.	Etabl. Postel-Vinay.	400	225	continuous	450	500	...
6	Garnier.	Etabl. Postel-Vinay.	135	75	"	150	500	...
7	Dujardin & Co.	Soc. l'Eclairage Electrique.	800	440	triphase	95	3,000	50
8	Biétrix, Nicolet & Co.	Soc. l'Eclairage Electrique.	350	190	continuous	760	250	...
9	P. & A Farcot.		850	480	biphase	155	2,200	42 5
10	Weyher & Richemond.	Daydé et Pillé.	1,000	560	continuous	2,240	250	...
11	Weyher & Richemond.	Cie Gle Electrique, Nancy.	500	280	triphase	52	3,000	50
12	Weyher & Richemond.	Electricité et Hydraulique.	1,000	560	"	150	2,200	50
13	Delaunay-Belleville.	Maison Bréguet.	1,250	700	"	190	2,200	50
14	Soc. Anciens Etab. Cail.	Cie Thomson-Houston.	1,200	675	"	65	5,500	25
15	Dujardin & Co.	Schneider & Cie.	1,500	840	"	230	3,000	50
16	Société Anonyme Hauts-Fourneaux, Maubeuge.		500	280	continuous	1,120	250	...
17	Soc. des Ind. Economiques gas engine.	Cie Gle Electrique, Nancy.	120	65	"	260	250	...

TABLE II.—FOREIGN SECTION.

—	Nationality.	Maker of engines.	Maker of dynamo machine.	Ind. H.P.	KW.	Nature of current.	Amps.	Volts.	Frequency.
21	Great Britain	Robey.		500	280	continuous	1,120	250	...
22	"	Willans & Robinson.	Siemens Brothers.	2,400	1,340	"	2,630	500	...
23	"	Galloway.	Mather & Platt.	500	280	"	1,120	250	...
24	Holland ...	Stork.	Electrotech. Industrie.	550	300	"	600	500	...
25	Germany ...	Augsbourg.	Helios Elek. Anl. Act. Ges.	1,900	1,020	altern. single	480	2,200	50
26	" ...	Nurnberg.	Schuckert.	2,000	1,120	triphase	100	5,000	50
27	" ...	Borsig.	Siemens & Halske.	2,230	1,250	"	340	2,200	50
28	" ...	Nurnberg.	Lahmeyer.	1,400	785	"	95	5,000	50
29	Belgium ...	Carels.	Kolben.	1,000	560	"	150	3,000	50
30	"	Bollinckx.	Electricité et Hydraulique.	1,100	620	"	170	2,200	42
31	"	Van den Kerchove.	Pieper.	1,000	560	"	150	2,200	50
32	Austria ...	Ringhoffer.	Siemens & Halske.	1,600	900	continuous	1,800	500	...
33	" ...	Erste Brunner.	Ganz.	910	510	triphase	140	2 200	42
34	Hungary ...	Lang.	Ganz.	1,200	670	"	180	2,200	50
35	Switzerland	Sulzer.	Oerlikon Company.	400	250	altern. single	110	2,200	50
38	"	Escher-Wyss.	Oerlikon Company.	900	500	triphase	135	2,200	50
39	"	Mertz.	Alioth.	360	200	continuous	400	500	...
40	Italy ...	Tosi.	Schuckert.	1,200	675	"	1,400	500	...
41	" ...	Tosi.	Bacini.	600	350	"	700	500	...

2,400-H.P. engine, coupled to Siemens dynamo, gives a larger output than any other set in the Exhibition, although on account of the high speed it is, of course, not the largest in bulk.

Coming now to the boilers, which are in two batteries, there are in all 92 boilers divided amongst 18 different firms as tabulated in Table IV. The largest groups are those of J. & A. Niclausse, Babcock and Wilcox, and Naeyer & Co., with 21, 14, and 10 respectively. It will be noticed that the majority of the boilers

TABLE IV.—BOILERS.

—	Names of makers.	Number of boilers.	Type of boiler.	Production in kg. of steam.
1 & 15	J. & A. Niclausse, Paris ...	21	water-tube	35,000
2	Crepelle-Fontaine, la Madeleine-lèz-Lille	1	"	3,000
3 & 16	Société des Générateurs Mathot, Rœux-les-Arras	7	"	28,500
4 & 14	Babcock & Wilcox, Paris...	14	"	35,000
5	Roser & Co., St. Denis ...	6	"	20,000
6	Montupet, Paris	5 1	" semi-tubular	10,000
7	Bérix, Leflaive, Nicolet, St. Etienne	1	water-tube	2,700
7	Solignac, Grille & Co., Paris	1	"	1,150
8	Compagnie de Fives-Lille, Lille	3	semi-tubular	6,250
9 & 12	De Naeyer & Co., Willebroeck	10	water-tube	35,000
11	Galloway's, Ld., Manchester	6	Galloway	15,000
13	Fitzner & Gamper, Sosnowicz	1	water-tube	2,000
17	Steinmüller, Gummersbach	5	"	17,500
18	Petry-Dereux, Düren ...	1	"	3,720
19 20	Ewald Berninghaus, Duisbourg	5	Cornish	12,700
21	Petzold, Düren	1	"	2,160
22	Simonis & Lanz, Berlin ...	1	water-tube	3,250
23	Pauksch	2	Cornish	1,700

are of the water-tube type. When all the boilers are working at full power they will evaporate 234,630 kilogrammes of water per hour. Assuming, however, that the load is only 200,000 kilogrammes in actual working, then with 7½ kilogrammes evaporated per kilogramme of fuel, the total consumption of coal per day of seven hours comes out at about 200 tons.

A TWO-PHASE PLANT IN A BLEACHING WORKS.

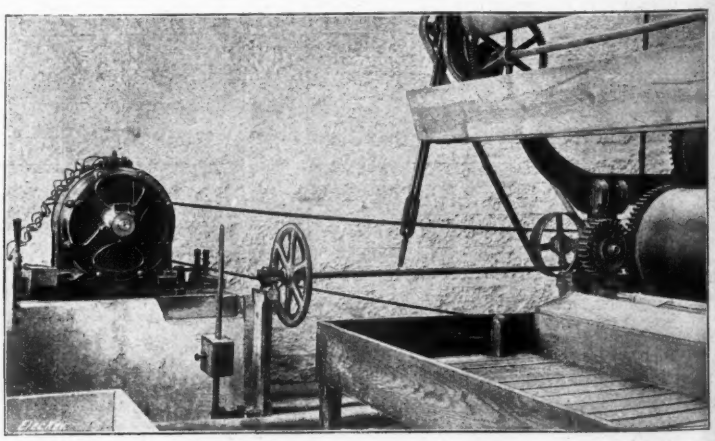
THE modern bleaching works contains much machinery which is in continual operation during working hours. Many of the machines employed in the process require a constant supply of energy, and the accompanying illustrations show how readily adaptable a two-phase system of distribution is for such purposes. The photographs were taken at the works of J. Burt-Marshall, Esq., Luncarty, near Perth, where a plant has been in successful operation for some time. The power is supplied from a low speed mill engine which drives a countershaft through a rope transmission. The countershaft carries a spur gear which meshes with a pinion on an auxiliary shaft. From this shaft two two-phase Westinghouse alternators are driven, also a small exciter, as can be seen in one of the illustrations. The alternators are eight-pole two-phase machines of 60 KW. each. They generate current at 220 volts with a periodicity of 120. The exciting current necessary for full load is seven amperes at 125 volts, part of which is supplied from the exciter and part by the auxiliary winding on the armature of the alternators, the current through which is proportional to the main current. This current is commutated into a direct current by the small commutator shown on the outside of the bearing, it is generated in the secondary of a small transformer located within the spider of the armature, the primary of which receives current at full pressure. By this means the machines are self-regulating.

The Westinghouse switchboard consists of four panels, one for each generator and two feeder panels. The generator panels each contain a voltmeter, two ammeters for the two phases, and the necessary switches for the two-phase circuits together with synchronising apparatus, for the alternators are worked in parallel. Rheostats governing the alternator field current are located on each generator panel.

The two-phase current is converted into mechanical energy through Westinghouse induction motors, two photographs of which are shown of the smaller sizes. There are two 75-H.P., one 20-H.P., one 10-H.P., one 7½-H.P., and one 5-H.P. motors distributed throughout the works and driving through belts. These motors are of the Westinghouse standard two-phase induction type. The motor can be reversed by means of the switch shown in one of the illustrations when it is necessary to alter the direction of the rolls.

In addition to the motor load, the works are lighted with incandescent lamps supplied through transformers from the alternators.

The flexibility of the two-phase system of distribution is well illustrated by this installation. The low pressure carried makes it free from danger, and the alternators respond quickly to sudden changes of load which occur during the stopping and starting of the motors.



TWO-PHASE PLANT IN A BLEACHING WORKS.

LEGAL.

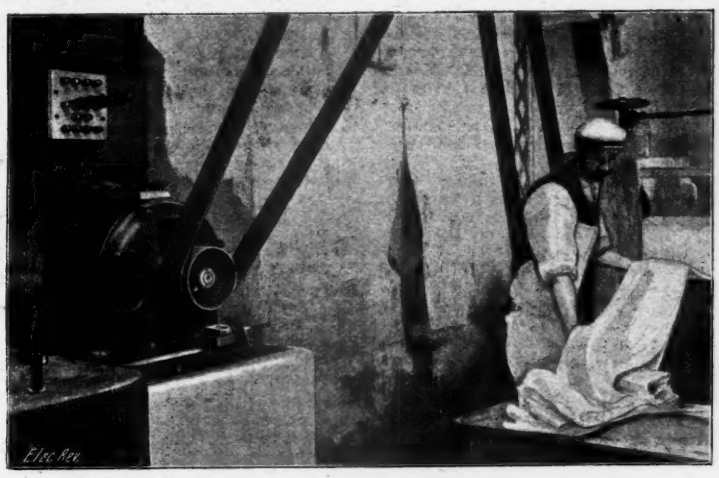
CHAMBERLAIN & HOOKHAM *v.* MAYOR OF BRADFORD.

An Important Judgment.

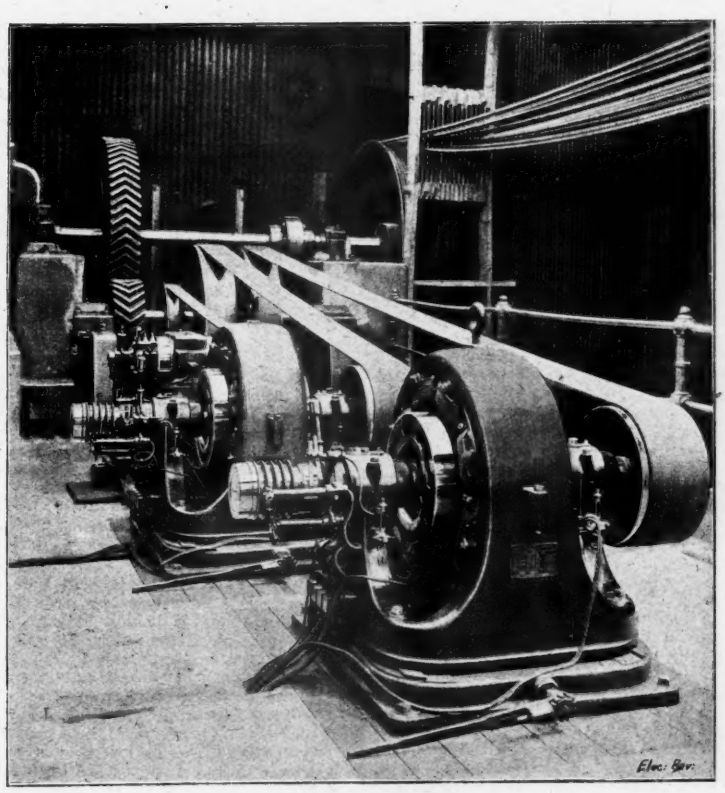
MR. JUSTICE FARWELL, in the Chancery Division on Friday last, delivered judgment in this case. The facts sufficiently appear from the judgment.

Mr. Justice FARWELL said: The plaintiffs seek for an injunction to restrain infringement of this patent, No. 4,225, of 1887, for improvements in electricity meters, parts of which improvements are applicable to dynamo electro-generators and motors. The defence is a denial of the infringement, and a plea of the invalidity of the patent. The plaintiffs' patent has been before the Court in another action, tried before Mr. Justice Wills in February, 1897, when, on the evidence before him, he granted the relief asked for against Johnson, the defendant in that action, and gave the usual certificate that the validity of the patent had come in question. I propose to adopt the judgment of Mr. Justice Wills on all questions of law determined by him in that action. The plaintiffs' complaints in the present action are confined to claims 1 and 3 in his specification. With respect to the first claim Mr. Justice Wills has held, and both sides agree, that this is a claim for a combination, that is to say, that the invention consists in the combination in the plaintiffs' meter of a number of appliances either for the purpose of producing a new result, or for the purpose of producing an old result by new means. The appliances combined may be either new or old, or partly new and partly old, and the patent may, if aptly framed, effectually claim pro-

tection for such of the appliances as are novel, as subordinate integers in addition to the invention contained in the combination and protected by the patent. It is contended in the present case that the third claim is not merely a branch of the combination, but is also an independent integral claim. It is also contended by the plaintiff that he introduced for practical purposes a new principle or idea in the construction of meters. It is, of course, well settled that a mere idea or principle cannot be the subject matter of a patent; there must be some concrete form to which the principle is applied, and that concrete form must be defined and limited, for if the claim is in general terms for every mode of carrying the principle into effect it becomes a claim to the principle itself and fails. I propose to apply these propositions in determining this action. The first question that I have to consider is that stated by Lord Justice Cotton in Proctor *v.* Bennis, 31 Chancery Division, page 754, "Has the plaintiffs' combination in substance been taken, has the defendant, though not taking exactly the whole combination patented, taken by slight variations, mechanical equivalents, the substance of it, so as to produce the same result by practically the same means?" In answering this question, I have to bear in mind the distinction pointed out by Wood, Vice-Chancellor in Curtis *v.* Platt (3, Chancery Division 135), that where the invention is for the production of a result already known and attained, the protection afforded by the patent is confined to the particular means pointed out by the specification, and the same result may be attained without infringement by another person by the use of mechanical equivalents; in other words, the invention of a combination of processes leading to a known result does not prevent other persons from arriving at the same result by a combination of other processes; but if the result is novel in that it produces a new instrument or involves the practical application of a new principle, the defendant infringes by substituting known equivalents. To use Lord Bowen's words (36, Ch. Div. 764), "When there is really an ingenious novelty, the idea that the combination will produce a new result, that novelty in the idea is part of the merit of the very combination." Now in this case the object to be produced is an electricity meter for lighting and motor purposes; such meters were not new in 1887. Electricity, as a mode of lighting, was well known, certainly before 1882, when the first General Act relating to electric lighting was passed, and meters for the purpose of measuring the article supplied were a necessary adjunct for the commercial success of any system of lighting. Mr. Ferranti made meters in 1884, and Mr. Edison at or before the same time. Those meters were, of course, of a different type to the plaintiffs', but they were not the less instruments for measuring electricity. But then it is said that the plaintiff discovered and applied for the purpose of his meter a novel principle, namely, that magnets could be at the same time permanent and powerful; he stated that before 1887, although permanent magnets had been known and used as constant with a weak field, yet when magnetised so as to become powerful, their constancy was not only unknown, but not believed in. He said in effect that permanent magnets were really considered inapplicable for the purposes of a meter by reason of the incompatibility of power and constancy, a fallacy which he considers he exploded. This is material from the point of view of the principles which have already stated that if this idea is really novel it would form part of the invention found in the combination within the meaning of the words of Lord Bowen quoted above. But on the evidence I find the contrary to be the fact: I think I do no injustice to the plaintiff if I look at his own specification to assist me in judging of the probability of the reality of this alleged discovery. One would expect to find there a statement of the new principle, and not the less because it was destructive of an old fallacy. If a patentee had really discovered for the first time that power and constancy were compatible, and knew that all other electricians believed them incompatible, he would never direct the construction of an instrument with very powerful and very constant permanent magnets without calling attention to the fact that the existing belief with reference thereto was fallacious. He would surely know that the expert, uninstructed as to this, would at once cast aside his specification as that of an impracticable dreamer. I have further than this the oral evidence of witnesses of experience and standing entirely contradicting the plaintiffs' statement. Further than this, the specification really states no tangible principle at all; all magnets necessarily have some constancy and some strength; to say that magnets are to be used which are both powerful and constant, is simply to state that you must make your magnet as powerful as is consistent with its constancy, it becomes a mere question of degree, and no principle is involved, and no practical direction given in the specification. Further, it is clear on the evidence that before 1887, the practice of ageing powerful magnets, and thereby making them constant, was well known. There was nothing to prevent the defendant from rendering his magnets constant by artificial ageing, and from using two or three if one was found insufficient, and the defendants, in fact, used formerly three, and now use two comparatively weak magnets which have been rendered constant by a very special process of ageing described by one of the witnesses. I conclude, therefore, that there is neither novelty of object aimed at, nor of idea or principle involved, and I approach the consideration of claim 1 as a combination patent pure and simple. Now, the objects aimed at by the plaintiffs and defendants are different in this respect. Both make a meter; but the plaintiffs is a current meter, the defendants is an energy meter. The distinction



Two-phase Plant in a Bleaching Works.



Two-phase Plant in a Bleaching Works.

is to my mind material. The current meter measures current only, and is incapable of measuring anything else. The energy meter measures the energy—that is, both the pressure and the quantity. The Board of Trade unit is energy, not current. Mr. Ferranti stated the essential difference to be that in an energy meter the two parts of the motor, namely, the armature and the field, must be connected, the one in circuit into the lamps to be measured, the other across the circuit, so as to receive the voltage of the circuit. The current meter deals only with the main current of the circuit flowing to the lamps. Further, it is essential to a current meter, and is so stated in the specification, that there must of necessity be an electromotor with a constant, or nearly constant, field. In an energy meter such a constant field would be destructive. Further, the energy meter will not directly measure current at all. It is true that if you have, in fact, a constant potential, you can calculate from your energy meter, and the amount of energy shows thereby what amount of current has passed. Mr. Moulton founded an ingenious argument on this. He said that by Act of Parliament the potential was allowed to vary only to the extent of 3 or 4 per cent., so that it must be practically constant, and that at Bradford the defendants' supply was so good and regular that the potential was practically constant, and further, that the defendants knew and intended that their meter would measure current, in effect, because of the use by the defendants of a compound winding for the purpose of starting. This was originally the second claim in the patent, but was struck out and is admitted to be old. It is said, however, that this compound winding involves as a necessary consequence the existence of a constant potential, constant, that is, in the sense that a meter supplied with this and adapted for a circuit of 100 volts could not be used on a circuit of 200 volts. All these contentions appear to me to be fallacious. The fact that the defendants at Bradford have hitherto supplied electricity at a constant uniform pressure does not render it unnecessary to have a meter capable of measuring, whether they do or do not keep up such uniformity. To hear is not necessarily to obey, even between an electric lighting company and the Board of Trade, and to say that the defendants had not proved that they have deviated in the past from the Board of Trade regulations is to attempt to turn their virtue against them in a way quite unwarrantable. The point as to the compound winding also comes to nothing. It is usual to have currents of either 100 volts or 200 volts, and it is not usual to vary the voltage more than a small percentage, say, 15. The use of an old appliance for a circuit of a particular voltage is in no way inconsistent with the measurement of the variations of energy possible within the range of fluctuation usual in such a circuit. It is perhaps not immaterial to add that in the case before Mr. Justice Wills the defendant used a current meter, and the present plaintiff in that act relied, and in part succeeded, on the distinction between energy and current meters, and further, the plaintiff told me that he himself gave evidence as to the distinction, and accepted his counsel's statement that he had taken the simpler problem. Further, the plaintiff, at about the same time that he took out his present patent, obtained another patent for an energy meter, and accurately described his energy meter as combining the parts of electromotors of the kinds described, whereby the driving force acting on its armature is proportional both to the quantity of the current to be metered, and to its electric force. Further, I hold, on the evidence, that the defendants' energy meter will work with alternating currents, and that a meter made in accordance with the directions in the plaintiffs' specification would not, so that the defendants' meter not only measures that which the plaintiffs will not, namely energy, but is also appropriate to currents to which the plaintiffs' is not. The plaintiff is in this dilemma—if he claims that his patent extends to alternating currents, he has given no directions by which an instrument could be made to work therewith, and his patent would therefore be void. If, on the other hand, he does not claim that it is within his patent, he admits that the defendants' meter performs an important function that his cannot. It is not necessary for me to determine on which horn of the dilemma the plaintiff is impaled, but I will assume the latter, as being more favourable to him, and I do this the more readily as the defendant does not press me to hold the plaintiffs' patent bad unless it is absolutely necessary to his case. It appeared in evidence that in 1887 alternating currents were little used in a manner which required to be metered, and that no machine for alternating currents had, in fact, ever been made, or attempted to be made, in accordance with the plaintiffs' specification. I hold, therefore, that the object aimed at and attained by the defendants' meter is both more extensive and more practically useful than that attained by the plaintiffs. Then it is said by the plaintiffs that the defendant has taken the material part of his combination, and has used the governing idea suggested by the inventor. Both the meters necessarily have a motor to supply the driving power, and a magnet to supply the braking power, and a commutator. The great practical difficulty experienced by inventors in devising a form of meter that would work, was static friction; as Mr. Hookham put it, "The forces at our disposal that act for us, are so extremely small that we should say that static friction which obeys the wrong law, is our principal difficulty." In order to obviate this difficulty, Mr. Hookham commences by enlarging and making as powerful as possible the forces which act in the right way as he put it, "It is the exaggeration of the electrical forces which is as important as the diminution of the static friction." This diminution is effected partly by the mechanical contrivance of bars or anti-friction rollers, and this also which he regarded as more important, by a commutator which acted by means of mercury cups instead of ordinary solid brushes. His complaint is, in fact, that the central idea, namely, the exaggeration of the electrical forces is his idea, and is taken by the defendants. He admits that the defendants' commutator and other mechanical anti-friction contrivances are entirely different from his own, but so far as the combination claim is concerned (having regard to what I have already decided as to the knowledge of the possibility of the co-existence of power and constancy in magnets) any argument in support of claim 1 must rest on the novelty of the use to which the idea of this exaggeration of forces is applied. The substance of the argument, as I understand it, was put thus by Mr. Moulton; the two things that Hookham found out were these: (1) that he could have his brake so powerful in the way adopted by him that he could afford to have a large driving power; and (2) that he could make a commutator so frictionless that with that brake power he could get practical accuracy; and he says that the combination of these two steps was Hookham's invention and ensured success. But I find as a fact that it was known before 1887 that you could by the exaggeration of the electrical forces render the amount of friction with which you had to deal less important. In addition to the oral evidence I refer to Uppenborn's paper of February, 1884, and Marcel Deprez's patent, January, 1884, and Ayrton and Perry's patent. There always remained a residuum of friction, too great to be got over by mechanical appliances, if any commutation that was known prior to 1887 was used in the meter. The new step taken by Hookham in his meter was that he invented a form of commutator with an ingenious arrangement of mercury cups, whereby he avoided the friction produced and then supposed to be necessarily produced by brushes altogether. The real step in advance that Hookham took as compared with Ayrton and Perry was the addition of this commutator to the means for exaggerating the electrical forces which were then well known. Both Ayrton and Perry, Marcel Deprez, Siemens, and the plaintiff exaggerated their magnetic forces, but this exaggeration was not sufficient to ensure success for any of them. But the defendant used a commutator of an absolutely different nature from the plaintiffs'. He has solved another problem, and has shown that brushes can be successfully used if they are silver-tipped and if silver is used in other respects, as pointed out by the witnesses. This is not the case of a mere mechanical equivalent, but of a new appliance. The plaintiffs' case on claim 1, in my judgment, fails entirely. There remains claim 3, and as to that, Mr. Moulton says that claim 3 is not a combination, but a subordinate integer, and he claims that his client is entitled to an electricity meter, to a monopoly for permanent magnets, rendered permanent and constant by their special form, used to form either the brake or the armature field. Now the plaintiffs' magnet is what has been called a compound or built-up magnet, and is absolutely dissimilar in form to the defendants'. The plaintiffs' is of a very special form; the defendants' is the common horse-shoe, and the witnesses say that that form is a material circumstance in considering a magnet. If Mr. Moulton were claiming as his subordinate integer the particular form of magnet described in his specification and drawings, and no other, he might possibly rely upon Mr. Justice Wills' judgment as a decision in his favour. His Lordship says that Hookham did invent a form of permanent magnet, with great splayed ends where the continuity was broken. I understand this to mean a magnet, such as is described in the specification, as having very large polar surfaces closely fronting each other, so as to form a narrow slit in which the disc armature revolves. In the case before Mr. Justice Wills the defendant used a magnet similar to the plaintiffs' magnet, and was restrained, but this will not be sufficient for the plaintiffs in the present case, and Mr. Moulton, in fact, claims a monopoly of all magnets with large polar surfaces close together. I have very great doubt whether such a claim could ever be sustained; it is exceedingly difficult to say what is large in respect to surface and what is close together, and while I feel convinced that Mr. Justice Wills did not decide this point in any way that amounts to plaintiffs' contention, I am not quite sure that he meant to decide that the particular form of magnet was well claimed as an independent subordinate integer. I should myself read the third claim as subsidiary to the first, so that the novel form of magnet is claimed as one portion of a combination and not as a separate invention. But however this may be, I am of opinion that the defendants' magnet does not come within any fair interpretation of the plaintiffs' description of permanent magnets with very large polar surfaces. Further than this, in my opinion, permanent magnets with polar surfaces closely fronting each other so as to form a narrow slit, in which the disc armature revolves, were known before 1887, and there is no novelty in anything that the plaintiff claims in claim 3 unless it be the particular form of his magnet. As Mr. Justice Wills puts it in his judgment, the idea of using the Foucault currents for producing braking action is clearly not new, nor is the idea, in a general way at least, of applying the braking action to an electricity meter. He points out that it is described in definite terms in Ayrton and Perry's specification—the revolution of magnets in front of a disc being indistinguishable in principle from the revolution of a disc in front of the magnets. In addition to the evidence before Mr. Justice Wills, I have Siemens's energy measurer, with Marcel Deprez's paper thereon in 1884. Siemens's instrument had an axis with wings revolving in paraffin; Marcel Deprez's suggested in 1884 an improvement upon this, by substituting for it a copper disc revolving between the poles of a permanent magnet, and he continues: "The rotation of the disc between the poles of the magnet will have the effect of developing in the interior of the disc induced currents, following a well-known law which I formerly applied in my magnetic speed indicator, exercising on the magnet a magnetic force proportional to the first power of the speed." This accurately describes the defendants' machine. It is true that it does not describe any particular form of magnet, but ordinary horse-shoe magnets with polar surfaces, close to each other, were well known, and the magnetic speed indicator to which the writer referred, is described in a paper dated 1881, which contains drawings of magnets, two of which (figs. 5 and 7) are practically indistinguishable from the defendants' magnets. As a matter of construction of Marcel Deprez's paper of 1884, I should say that the magnet that would be naturally taken by the reader in the absence of specific directions would be one of the magnets shown in the drawings relating to the

speed indicator therein mentioned. For these reasons I come to the conclusion that the plaintiff has failed to show any infringement of his patent, and it is therefore unnecessary for me to express any opinion as to the validity of the patent. I dismiss the action with costs, and I see no reason for making any distinction between the costs of the action so far as it relates to the validity of the patent.

The action was accordingly dismissed.

BILLS BEFORE PARLIAMENTARY COMMITTEES.

Manchester Corporation Tramways.

A committee of the House of Lords, of which Lord Newton is president, sat on Thursday last week to consider the Manchester Corporation Tramways Bill.

Mr. Lewis Coward, who appeared for the promoters, said that the Corporation owned the tramways in the city, and at present they were worked under a lease by horse traction by the Manchester Carriage and Tramway Company. That lease would expire in April, 1901, and the Corporation intended to work the tramways themselves by electricity on the overhead trolley system. In 1898 the Carriage and Tramway Company introduced a Bill for power to introduce electric traction, but that Bill was rejected. The Corporation sought to extend the tramway system both within the city and in adjacent boroughs with the consent of the local authorities.

Mr. Boyle (chairman of the Manchester Tramway Committee), giving evidence in support of the Bill, said that the Corporation were most anxious to relieve the congested state of the traffic in Market Street, and that as the electric cars would be without horses, they would take up much less room than ordinary horse vehicles.

On Wednesday the Chief Constable of Manchester spoke of the great inconvenience of the present system of tramways, and the great congestion of traffic it led to. Under the new system with electricity as the motive power, the cars would travel quicker, and there would be fixed stopping places.

The Town Clerk of Middleton, said the Borough of Middleton had voluntarily entered into the agreement scheduled in the Bill in regard to a tramway system connecting Middleton and Manchester.

The Committee decided to pass the Bill.

Blackpool, St. Anne's and Lytham Tramways.

On Wednesday and Thursday last week, Mr. W. H. Holland's Committee of the House of Commons considered the Bill promoted by the Blackpool, St. Anne's, and Lytham Tramways Company to obtain powers to lay down a double line of tramway between Blackpool and Lytham. Opposition was offered by the Corporation of Blackpool and by a number of owners of property.

It was explained by the promoters that the existing tramline, which was electrically worked, had been opened since 1898. At present the company were allowed to run the tramways at the rate of 8 miles an hour, but this they asked to be allowed to increase to 12 miles, the increased speed having been sanctioned by the Board of Trade.

Having heard evidence the Committee found the preamble proved.

Sandgate and Hythe Tramway.

The House of Lords Committee, presided over by Lord Brougham, on 24th ult. had before it the scheme of the Sandgate and Hythe Electric Company to construct tram-roads from New Romney to Folkestone, to be worked by electricity on the overhead trolley system. The Committee decided to reject the scheme.

Huddersfield Corporation Tramways.

On Tuesday and Wednesday last week, the Select Committee of the House of Commons, presided over by Mr. Jeffreys, had the recommitted Bill of the Huddersfield Corporation before them. The Bill was originally before the Committee in March and was reported in the Electrical Review of March 23rd. Powers were sought to convert the tramways from steam to electric traction, and to extend them both inside and outside the borough. The capital for the outside extensions would be found by the Corporation and they would work them, but the local authorities concerned would have the option of purchasing the portions within their areas at the end of 21 years. The capital powers asked for were £399,000. In March the Committee approved of the extensions inside the borough, but in view of the fact that notice had been given of the appointment of a Committee on Municipal Trading they did not consider they ought to grant such a large and extensive system of tramways as was sought outside the borough boundaries.

The Chairman now announced that the House had relieved them of this difficulty by passing a resolution authorising them to consider and report as to the expediency of re-inserting in the Bill the powers to construct additional tramways outside the borough.

Mr. Balfour Browne, Q.C., addressed the Committee in support of the Bill, and said that the opposition of the Lancashire and Yorkshire Railway was now withdrawn.

The Chairman pointed out that it looked as if the Huddersfield Corporation were going to exploit the outside districts for its own profit, and the Committee would like to know if the other local authorities were going to get any share of profit.

Mr. Balfour Browne said the Corporation stood the risk and took the profit, but there would be a provision inserted giving the local authorities power to purchase at the end of 21 years, and they would take over a valuable undertaking at the price of old iron.

Evidence was then called to show the need of tramways in the district.

Replying to the Chairman, Mr. Ram, Q.C., said it was estimated that roughly £140,000 would be spent in the outside districts. The expenses of promoting the Bill would be paid out of the rates. There were borrowing powers in the Bill providing that the costs should be repayable in five years, and the remainder of the expenditure was to be repaid in 30 years or less, as the Board of Trade might direct.

The Chairman said the Committee thought the expenses ought to be paid in three years.

The Committee declared the preamble of the Bill proved, and in the consideration of the clauses no alteration was made as to the period of repayment of the expenses.

Glasgow District Tramways Bill.

A Committee of the House of Lords, presided over by Lord Herries, commenced on Thursday of last week the consideration of the above Bill, by which it was proposed to incorporate a company, and to authorise the construction of certain tramways in Renfrewshire and Lanarkshire.

Mr. Pembroke Stephens opened the case for the promoters, and said that it might be stated that the promoters came before the Committee with the goodwill of the local authorities concerned. The gauge would be the same as on the existing systems, and the tramways would be worked by electricity.

Mr. Wm. Barrington, who prepared the plans for the scheme, said the system adopted was the overhead trolley system. The gauge was the same as that of the tramways of the Glasgow Corporation, viz., 4 feet 7½ inches. A general point of opposition stated in all the railway petitions was, that an electrical system would interfere with their electric signalling apparatus, but there was absolutely nothing in that, where the wires were properly insulated. The total estimate for the works was about £180,000, which included £30,000 for generating stations in Paisley and Renfrew.

A great deal of evidence was then called to prove the inadequacy of the existing tramway system in the districts.

On Friday, evidence was given in support of the Bill by many local witnesses.

Mr. John Mathieson, treasurer of the Burgh of Paisley, said he felt satisfied that a good system of electric cars, such as was proposed to be given by the promoters of the Bill, would be of great advantage to Paisley and the surrounding districts. Personally, he inclined to the opinion that for some years the tramways would not be a financial success, and he felt sure they would result in a loss if managed by the Paisley Town Council.

Mr. James Donaldson (consulting engineer), Glasgow, said he was sure that public opinion in Renfrew was strongly in favour of the Bill.

Mr. W. M. Murphy, chairman of the Dublin United Tramways Company, and one of the promoters of the Bill, said that the Dublin Tramways were the largest system of electric tramways in the United Kingdom. They were all worked from one generating station, which was the largest in the country, and one of the best equipped in the world. As a capitalist, he was satisfied that the scheme would show a fair profit, and he felt no doubt whatever that the necessary capital would be forthcoming.

Mr. Erskine Pollock, in opening the case for the opponents of the Bill, addressed the Committee on behalf of the Glasgow and Renfrew District Railway Company, and maintained that if the scheme was sanctioned the interests of his clients would be very seriously prejudiced.

Evidence was then called in support of the opposition, and the Committee adjourned till Monday, when Mr Lewis, chairman of the Parliamentary Bills Committee of the Lanarkshire County Council, said that his Council opposed the Bill, chiefly on the ground that the scheme of the promoters failed to give a through service to Glasgow.

After hearing further evidence in opposition to the Bill, the Committee adjourned until Tuesday.

On Tuesday the Select Committee, presided over by Lord Herries, concluded their consideration of the Bill promoted by Mr. Murphy's syndicate for the construction of electric tramways in Paisley, Renfrew, Johnstone, and the surrounding districts.

It was stated by Mr. Pembroke Stephens, for the promoters, that all matters in disagreement with Paisley, Renfrew, and Johnstone, had been arranged during the interval since the Committee last sat, and the only remaining difficulty—a small one—was with the Renfrewshire County Council. They had also settled with the chairman of the Committee of the House of Lords the shape which the clauses in the Bill should take, and there was a new clause with reference to the purchase of the undertaking by the local authorities within the time mentioned with the approval of the Board of Trade.

Mr. Pope objected to the general laws as expressed in the Tramways Act of 1870 being modified without evidence in support of the modification having been given simply because the two parties there had come to an agreement.

The CHAIRMAN pointed out that the general Tramways Act was passed before the days of electric tramways, and he could quite understand that some alteration in its provision might be necessary at the present time. It seemed to him that, in respect to this agreement, if the parties were agreed that was sufficient.

After discussion amongst the parties the difficulty with the Renfrewshire County Council, which had reference to the question of purchase, was arranged, and the Committee passed the preamble of the Bill and ordered it to be reported to the House.

LANCASHIRE ELECTRICAL POWER BILL.

SIR JAMES KITSON'S Committee commenced late on Wednesday last week the consideration of the Lancashire Electrical Power Bill. Mr. Worsley Taylor, Q.C., Mr. Erskine Pollock, Q.C., and Mr. Shaw appeared for the promoters. Amongst the opponents were the Liverpool Corporation, the Manchester Corporation, the Corporations of Widnes, Wigan, Ashton-under-Lyne, and Leigh, represented by Mr. Balfour Browne, Q.C., Mr. Freeman, Q.C., Mr. Lewis Coward, and Mr. Rhodes; Warrington, Salford, Bacup, Stockport, Oldham, Bolton, Eccles Corporations with counsel reserved; the Southport Corporation, represented by Mr. Davies Williams, the Urban District Councils of Stretford, Withington, Moss Side, Levenshulme, Worsley, Farnworth, Hindley, Abeam, Gorton and Withnell; the Manchester Ship Canal Company, and the Manchester Carriage and Tramways Company.

Mr. WORSLEY TAYLOR, Q.C., in opening the case for the promoters, said that the announcement which had been made earlier in the day in connection with the County of Durham Electrical Power Bill and the Tyneside Electrical Power Bill had considerably narrowed the scope of the observations it would be necessary for him to make in bringing the Lancashire Bill before the Committee. The points to which he would direct his attention were these:—(1) The scope of the powers of the Bill in relation to the area they proposed to serve and to the public in that area; (2) the question of the suitability of the area for supply; and (3) the financial capacity of the promoters to carry out the undertaking. Upon the first point he would say that under clauses introduced into the Bill they could not compete either directly or indirectly with any local authority or company already authorised by license, order, or special Act to supply energy within the area of supply. The promoters could not supply directly to the customers of those local authorities or companies. They sought authority to supply on behalf of a local authority which had already got the power to do so, but only as the agents or servants of that local authority. The powers of the company were therefore strictly limited. The only question between the promoters and the opponents was whether in any particular case there were some special circumstances for taking them out of the general rule that there ought to be a wayleave through their district. Then, with respect to the suitability of the area, it was of Lancashire south of the Ribble. It was the great coalfield of Lancashire, and was eminently suitable for the placing of their central generating stations, and the whole of it with the exception of that part round Southport was one great mass of industries and manufactures of all kinds. It would be almost impossible to find an area more suitable, or one which provided a more hopeful field for the enterprise of those who were willing to put their money into electrical generating concerns of the kind. The County Council had decided to support the scheme, and the mains would run along 1,500 miles of roads. At first, many local authorities opposed it, but now they understood the scheme more thoroughly, their opposition had been disarmed. There were 123 local authorities in the county. Sixteen of them possessed electrical works, and five had them in course of construction. The generating stations of the 16 authorities cost 1½ millions sterling, the aggregate generating power being 15,000 KW. Two-thirds of this power was produced by Manchester and Liverpool, the other third being allocated amongst 19 stations. In consequence of the difficulties standing in the way, 87 local authorities in the county had not applied for provisional orders to supply themselves with electricity within their area. The promoters intended to create four generating stations at Little Lever, near Bolton, Wigan, St. Helens, and Trafford Park, Manchester. From each station there would be 125 miles of cable, at a cost of £1,000 per mile, and the total cost of the station would be about £500,000. The capital of the company was proposed to be £3,000,000, and the usual borrowing powers would bring it up to £4,000,000. The promoters were a combination of local gentlemen largely interested in various industries in Lancashire, and gentlemen who were experts in electricity, and connected with very large electrical undertakings. If the opposition of the large towns was successful, many small local authorities would be prevented from getting electricity except from wealthy Corporations like Manchester and Liverpool. By far the larger number of the local authorities concerned offered no opposition to the Bill.

Mr. F. E. GRIPPER, an electrical engineer, and one of the promoters of the scheme, bore out counsel's opening statement, and said it was proposed to generate electricity on a larger scale than ever before attempted in the country. They had no intention of supplying electricity to any district unless they were invited by the local authority, and the only compulsory powers they sought were to lay mains through the various districts. In the mains they proposed to have a voltage of 10,000 volts, which could be transformed down to suit the requirements of local authorities or companies. The capacity of the plant at each generating station would be 12,500 KW. Assuming a load factor of 25 per cent., the output would be 27,370,000 units, and the estimated cost of generation and distribution would be 0·7d., amounting to about £79,000 per annum. They would supply the current at an average price of 1½d. per unit, which would produce about £142,000, leaving a profit on the business of £62,000 per annum on each generating station. He had not the least doubt that the promoters would be able to raise the required capital.

On Thursday Mr. GRIPPER was cross-examined, and said that the promoters would be obliged by their Bill to supply any corporation or company with electrical energy who asked for it, but they could not supply any individual unless the local authority gave its consent. He was not aware that a considerable number of local authorities had obtained provisional orders, and had agreed to hand them over to Manchester. He objected to Liverpool and Bootle being struck out of the Bill.

Replying to several members of the Committee, WITNESS said that as they would be responsible for the mains, they would object to them being laid by the local authorities, but there was no objection to the local authorities opening the streets. They would not object to a clause protecting the central part of Manchester.

Mr. W. W. B. HULTON, chairman of the Main Roads and Bridges Committee of the Lancashire Council, stated that the Committee had passed a resolution approving of the principle of the Bill. The Committee had information from various localities that such an electrical supply as was proposed was very necessary for the development of industries.

Other witnesses gave evidence in support of the Bill on behalf of industrial companies and firms working in the district.

At the sitting of the Committee on **Friday**, Mr. W. P. J. FAWCUS gave evidence, and expressed the opinion that the proposed scheme would give an efficient supply of electricity at a cheap rate. He did not see that there would be any difficulty in getting the necessary capital, and he thought that the works could be carried out for the amount which was estimated. He thought that the laying of the mains ought to be in the hands of the company, although the local authorities would under the ordinary law have the power of opening up the roads and charging the promoters for the cost. He should say that where local authorities were in a position to supply electricity themselves, they would not give their consent to the company supplying it.

Prof. SILVANUS THOMPSON said he considered that the scheme before the Committee was a perfectly feasible one, for there was no distance proposed to be covered which was too great to be successfully managed. The company were proposing to carry 5,000 H.P. in one main. The Board of Trade did not at present permit more than 1,300 H.P. to be carried in one cable. If, therefore, the Board refused to modify its rules the company might have to lay three or four cables in the same conduit pipe in order to get the requisite power, and this would no doubt to some extent increase the cost and also the interference with the streets.

Mr. JOHN RAWORTH said he considered that the absence of means for distributing electrical power in the country seriously affected the development of industries. It was known that most of the large towns in Lancashire had provisional orders, but the company could not enter those towns except with the consent of the local authority.

Further evidence having been called to show the great advantages which would accrue to industrial concerns in the area proposed to be covered by the supply of electrical power on a large scale, the case for the promoters was concluded.

Mr. WEDDERBURN, Q.C., who represented 15 urban district councils, said that after the intimation of the views of the Committee on the general principle, he proposed to confine himself to the question whether the passing of this particular Bill would be likely to ensure cheap and efficient power. He contended that the Bill would legalise an experiment which in all probability would fail, and which, while going through the process of failure, would have a hindering effect on the use of electrical power. This Bill was differentiated from the other Bills before the Committee by the fact of the enormous area proposed to be supplied—some 1,100 square miles as against 150 and 123 square miles proposed to be served by the Durham Bills. This area was vastly too large. It would be infinitely more reasonable to apply to serve a limited area, and, having done that successfully, they could then come for further powers. What he imagined would occur was that as soon as they had obtained power over the whole district they would form subsidiary companies who would go for provisional orders, and having done that would supply them with their power. Thus in time the company would be supplying other companies which, in effect, would be their nominees. They would, in effect, endeavour to acquire a monopoly, and this was one reason why, out of 123 local authorities, only eight or nine were supporting the scheme. The local authorities also opposed, because they could and in some cases did supply themselves as cheaply as this company could do the work, and if there was a profit they held that it should go to the municipality and not to the shareholders.

Mr. WEDDERBURN called Mr. R. HAMMOND, who said he did not think that the local authorities were being offered as good a condition of things as they could create for themselves.

In cross-examination, the WITNESS said he thought that the passing of that Bill might exclude a better Bill, and that in practice there would be no competition.

The Committee adjourned to June 18th.

DUBLIN ELECTRIC LIGHTING ACT.

FOR some days last week and part of the previous week a Select Committee of the House of Commons, under the chairmanship of Mr. A. H. Brown, considered a private Bill promoted by the citizens of Dublin for the lighting of the city by electricity.

Mr. BALFOUR BROWNE, Q.C., said that the promoters were tired of the continued inability of the Corporation to supply them with electricity. So far electric lighting had been a failure in Dublin. In 1890 the Corporation obtained a license, and they had spent £90,000. Instead, however, of there being a profit, there had only been an income

of £10,704, and a net revenue of £1,425, which had to meet the whole of the interest and sinking fund upon the £90,000. The promoters of the Bill considered that the loss was due to the fact that the Corporation had not done their duty to the public. The Corporation charged 7d. a unit for their light, with the result that the citizens would not take it, and at present there were only 250 consumers. The cables had proved unsatisfactory, and the station where the electricity was generated was one of the most unsuitable that could possibly be chosen. While, however, the Corporation had 250 consumers, no fewer than 60 private firms in the town were supplying themselves with electricity. The promoters of the Bill did not go to the Board of Trade for a provisional order because they required compulsory powers for the purchase of land. They had got a site on the river that would lend itself to the economical production of electricity. The action of the Dublin Corporation in connection with the electric lighting of the city had, he said, been to maintain the monopoly in their own hands, though they would do absolutely nothing to meet the wants of the ratepayers. The tramways company had offered to supply electricity to the Corporation at a reasonable price, but the offer was refused, the object of the Corporation apparently being to keep their dead hand upon the city and prevent any outside body doing anything in connection with the lighting. The result was that the ratepayers had been obliged to take the matter into their own hands. They came to the House asking for powers which the Corporation possessed, but would not put into operation. This new company expected to be able to supply at an average rate of 4½d. per unit, and if they did that they would be great benefactors indeed. The maximum which they asked power to charge was 6d.

Mr. Wm. Murphy, chairman of the Dublin Tramways Company, and a member of the syndicate promoting the Bill, said that the Tramways Company on two occasions had offered to take over the Corporation plant and supply to the public at a lower rate than the Corporation now did, but the offer had been treated with contempt. He believed the promoters of this Bill would make a profit, and was prepared to subscribe £10,000 to it himself.

The Witness was cross-examined at considerable length with a view to showing that the project was simply that of the Tramways Company, but this he denied.

On the question of the Tramways Company supplying the Corporation with electricity, Mr. Gordon, Q.C. (for the promoters), read a letter from the Town Clerk, which said the insuperable objection to such a course was that the company was debarred by statute from supplying any electricity except for the purposes of driving their own cars or lighting their own posts. With regard to this, Mr. Gordon said that all that would be necessary was for the Corporation to release the company from their agreement.

A number of witnesses having commercial interests in the city were called and complained of the inadequacy of the Corporation's supply of electricity, and considered that the syndicate promoting the Bill could do the work more economically and better.

Mr. Beater, the architect to Messrs. Arnott & Co., said that owing to his being unable to obtain a supply from the Corporation, he had had to put in an installation at a cost of £3,000 for that firm.

Mr. Hanley, electrical engineer, said the Dublin Corporation plant was equal to 1,500 H.P. and had 270 subscribers, as against a horse-power of 2,384 in the case of the 70 private plants now established. The Corporation plant was not suitable for the supply of motive power.

In cross-examination, Witness said he was aware that there was a great scheme in hand by the Corporation now, under Mr. Hammond, to light Dublin, but even then he thought competition would be beneficial.

Mr. A. E. Porte, electrical engineer, said that there were no motors in Dublin, although they had 400 in Cork, where it was in the hands of a company.

Mr. Parshall, electrical engineer, stated that the proposed generating station of the syndicate would supply electricity for lighting or energy at a cheaper rate than the 7d. per unit charged by the Corporation. He believed they would be able to sell at 4d. or 4½d. for lighting, and 2d. for power. He considered that why the Corporation cables failed was because they were not properly attended to. He considered that the syndicate would make a profit of £20,000 a year.

Mr. Pember, Q.C., addressing the Committee for the Corporation, pointed out that if the Bill was sanctioned, it would be absolutely unprecedented, for he had never known a Bill granted for the supplying of electricity in any town in competition with and against the wish of the local authority. Even supposing the Corporation were unwilling to carry out their obligations, that was a matter for the ratepayers. The failures which had taken place in the past were now at an end. The generating station had been established when the electric lighting question was really in its infancy, and when suddenly there was a large demand for current, the works proved incapable of supplying the demand. The same thing had, however, occurred in London, and many of the companies had had to come to Parliament to get powers to increase their stations, or supplement them by others. Now the Corporation had obtained Parliamentary powers to expend upwards of a quarter of a million to instal a perfect system.

Mr. Robert Hammond was called, and said that last year he was asked by the Dublin Corporation to report upon the proposed extensions of the city electric lighting scheme, and having studied the question on the spot, he reported. His estimate was £254,000 for an efficient scheme to cover the whole of Dublin, with 19 distributing centres. He considered that the Corporation would be able to supply electricity cheaper than the promoters of the Bill. He had no doubt as to the ultimate success of the Corporation scheme now that it was adequately equipped with capital.

Evidence was then called by the Corporation to show that the previous failure to supply properly was caused by want of capital, but as last year they had got their borrowing powers extended, this could be remedied.

The Chairman announced that the Committee had decided to pass the preamble of the Bill subject to the insertion of two conditions, viz., that the maximum of 6d. per unit should be reduced to 5d., and that the Corporation should have the power to purchase the company if at any future time they should wish to do so.

The Committee then proceeded to discuss the clauses of the Bill.

Central London Railway Bill.

On Monday Lord Morley's Committee of the House of Lords passed the Bill which has recently been introduced by the Central London Railway Company by special leave of the Standing Orders Committee. By this Bill the company is required to run "a sufficient number" of cheap trains for the labouring classes, "which shall be timed to arrive at both termini up to eight o'clock." By the Central London Railway Act, 1891, the company was only required to run "three trains each way every morning and evening, not later than seven in the morning or earlier than six in the evening." The fare chargeable by the company under the new Bill is not to exceed 2d. return for any distance.

MUNICIPAL TRADING.

The Earl of Crewe again presided on Friday over the second sitting of the Joint Committee on Municipal Trading.

Mr. Gray, counsel to the Chairman of Committees of the House of Lords, related the practice of the House in respect to applications by local authorities for powers for the supply of gas, water, electric lighting and tramways. He thought that the safeguards against objectionable provisions finding their way into an Act of Parliament were sufficient, except that in the case of opposed Bills clauses mutually agreed upon by contending parties were about to be passed without examination. The question could, however, be raised before the House should such clauses be deemed contrary to the practice of Parliament, or to public policy? It was a question whether for water purposes a combination of local authorities might not be more advantageous than small local bodies acting alone. With regard to the case of electric light, the power to supply outside the district was a recognised power under the Act of 1882. For tramway purposes local authorities usually proceeded by Bill, and nearly all electric light legislation was by way of Board of Trade provisional orders.

The Chairman: Speaking generally, I suppose it is the case that electric traction has come more into vogue since the extension of electric lighting. The two things are becoming more and more connected?—Yes. If the tramways are a company's undertaking, and the local authority has an electric lighting plant, the local authority as a rule will compel the company to take electricity from them, and, of course, there is a saving by their so doing, because there is no reason why there should be a double electric plant in a town.

Continuing, Witness said that with respect to tramways, it was provided by the Act of 1870 that provisional orders should be obtained from the Board of Trade, and it was necessary in all cases to obtain the consent of the local authority. Where it was proposed that a tramway should pass through the areas of a number of local authorities, it was provided that an order might be granted when the consent was gained from the local authorities who had jurisdiction over two-thirds of the line, but that so-called veto was not given in the case of Bills. He considered, however, that at present this veto worked rather badly, for a practice had sprung up amongst local authorities of demanding conditions. He thought the intention of Parliament was that local authorities should exercise a discretion as to whether tramways should be introduced into a town or particular streets of a town, to which there could be no objection, but there had been cases where the local authority demanded to share in the profits of the undertaking during the period fixed by Parliament as the company's tenure. He did not think complaint could be made of the action of the larger municipalities, but the local authorities tried to get as much as they could out of the concession. In many cases it was made a condition of consent that the tramway company should widen streets, and this forced companies to purchase more land than was required, and also forced them to pave more of the streets than was required of them under the Act. It was also frequently claimed by local authorities that they should be allowed the right to use the company's poles for electric lighting purposes, and they laid down what should be the kind of pole used, and so on. Many of these things would be passed without notice were it not for the chairman of the committee, who considered the Bills. As an instance of what was demanded, he might mention that in two Bills that session the local authorities had stipulated that all the officials of the District Council should have free passes over the lines; the condition was, however, ordered to be struck out before Committee. While he did not wish to say anything against municipal enterprise with regard to tramways, he could not help thinking it was bad for members of councils and their officers to have to haggle over such conditions, for it must ultimately lead to corruption in some form or other.

Mr. Grant Lawson, M.P.: Would the chairman of Committee consider it an unfair condition and strike it out if a municipality said to the promoters of an electric tramway Bill, "You must take your electricity from our generating station?"—No, he would not consider that an unfair requirement.

But would they not be able to kill competition in the supply of electricity by making such a condition?—No; it is not competition, because an electric company would have power to erect a generating station for the purpose of providing power for its tramway, but it would not enter into competition with the Corporation to supply electric lighting.

The Committee adjourned.

CORRESPONDENCE.

Specifications.

Being a constant reader of your excellent paper, I notice that you give space to the consideration of "Current Specifications."

There is a specimen of this literature in circulation which should not be overlooked, as it is interesting in many ways. No signature is attached, but I cannot presume modesty as the reason in one whose nerve sustained him in writing it, and submitting it through a public body.

In his next effort we may expect the author to assume more authority and commandeer what he requires from some favoured one, and pay what he likes, when he likes, or perhaps not at all unless he likes, for the accommodation.

I copy a few sentences from this specification, in the hope that some who are better known to us in connection with such work may learn to what extreme it has been carried, and that the unsuspecting contractor may know what it is possible to purchase for £1.

It would be well to point out that no mention is made in the specification of the number of lights to be installed, though we are informed that the incandescent lamps must be 100 volts 60 watts. Inquiry and an examination of plans showed that 15 new 16-C.P. lights were required, also a float containing 21 8-C.P. lamps, but these lamps are not specified nor any details of float given.

Some extracts of particular interest are as follows:—

"A watt-hour meter, or meters, as may be required, approved of, or supplied by the Metropolitan Electric Supply Company for alternating currents, of range sufficient, &c., with such additional margin for safety added, as may be required by the engineer, the Metropolitan Electric Supply Company, the London County Council, or any other authority concerned or interested must be supplied and fixed, &c., &c.

"Flexible cord 135/40" (130/40 which is a standard, will not do).

"*Insulation of Conductors.*—Special.

"*Joints.*—Must be left for examination of engineer before being insulated. They must then be properly insulated with pure rubber and vulcanized at a temperature between 290° and 300° F.

"*Drawings.*—All drawings in possession of the contractors at completion of contract to be returned forthwith, whether they were made at his expense or not.

"*Fire.*—Contractor to make good damages to the building or adjoining properties caused by fire arising out of this contract, whether or not caused by carelessness, &c., of his employés.

"Contractor to satisfy engineer by producing all vouchers, receipts, &c., for materials.

"Engineer to have access to the works, workshops, &c., of contractor and every place desired by the engineer without notice" (we only feel thankful that his private house has been spared).

"Approval of engineer shall not prevent him from subsequently condemning the same item, should the second inspection disclose a fault not revealed at first inspection.

"All parts of the work to be done by proper tradesmen. An electrician must not fix a wood block.

"*Testing.*—The contractor must provide such testing sets as the engineer may order, including portable battery, dynamo, electric machine, resistance boxes, meter of suitable type, and other things.

"*Payment.*—80 per cent. as certified by engineer, 10 per cent. in three months, and 10 per cent. in six months. Retention money may be applied to remedying any defects that may be apparent" (presumably without notice to the contractor).

Besides the above new work, the contractor is asked to estimate upon re-arranging a number of old circuits to suit the London County Council, no information being given or obtainable of the extent of the work.

A detailed schedule of prices attached to be filled in, and if any work beyond the contract is ordered and executed, the price of which appears to be excessive, "the engineer shall have power to fix a price at his sole discretion, which price shall be binding and final."

There are 17 foolscap pages of this specification, which, if published as a satire, would have been amusing, though hardly worth the price, but as an official document, the amusement it affords is considerably damped by the consciousness of time expended to redeem the £1 paid by

A Contractor.

Dublin Electric Lighting Scheme.

Heavy pressure of work has caused me to get behindhand in my reading of the technical journals, and on taking up yours of May 4th to-day I see for the first time a statement in your article on "Power Transmission" to the effect that in my specification for three-phase generators for the Dublin electricity works, I have "made it a condition of tendering that plant of similar size and type shall have been *actually made* by the tenderer," and I am sure you will allow me to point out to you that this is not the case.

The words in my specification are as follows:—

Maker—Any make of engine may be offered, of which examples of equal or larger size are in successful operation in the United Kingdom in public electricity supply works or on analogous duty, involving rapid and continuous fluctuations of load.

Under alternators I have not made any stipulation at all, but I have asked tenderers to fill in the following:—

Maker of Alternator—Size of largest three-phase alternator built by same maker.

Where three-phase alternator of same make can be seen in operation.

You will see that in the case of the alternators I have simply asked for information, and you will be interested to know that this request has not debarred British manufacturers from taking part in the competition for the contract.

Robert Hammond.

London, *May 26th*, 1900.

The Protection of Insulated Wires.

I have read Mr. Sydney F. Walker's article on the above subject with interest, as also Mr. Frederick Bathurst's comments thereon. Mr. Bathurst thinks that Mr. Walker, after all he says, leaves us in very much the same position as we were in before. But does Mr. Bathurst carry us much further? I am sure that every consulting engineer of repute is able to design a system of wiring which will be as permanent as the present methods of manufacture render it possible, if he is given a free hand in the matter of expense; but the difficulty to be contended with is that as a general rule the precautions and provisions appearing in the wiring specification which would be necessary for the attainment of the "best possible" in the existing state of our knowledge of the materials with which we have to work would be considered as "fads" on the part of the engineer consulted; and contractors, in their own interests as well as in that of the extension of electric lighting, would, without exception, criticise such precautions as unnecessary elaborations. Now, I am perfectly willing to admit that the character of wiring accidentally revealed in the course of the additions or alterations has occasionally been of such a character as to make one exclaim (inwardly), "If no fire or other untoward incident has been caused by this wiring, the elaborate precautions taken in specifications for good work would seem to be thrown away." It is simply astounding what current one strand of 3/22½ will carry with apparent immunity under circumstances which any engineer in his senses would strongly condemn. With the knowledge of the character of the wiring in many houses in London at the present time it is a matter of great surprise that an "electrical fire" does not take place more often than it does. It can only be assumed that the special providence which admittedly watches over children and drunken men has extended its good offices to the average householder who has not been responsible for the wires put into his house.

Mr. Bathurst seems to be an advocate of insulating lined pipes, one argument against unlined pipes being that one wire may become connected to the pipe, and that in this way neighbouring gas and water pipes may be seriously affected. This is a possible contingency, but does not the same argument apply to leaks from the supply companies' mains, in comparison with which the leak from a wire by its unlined pipe, would in general be practically negligible?

Mr. Bathurst sums up the bearing of his experience on the subject generally, by saying that "the growth and development of the art will, in spite of 'low first cost' requirements, tend to favour the use of highest quality material, and that the workmanship required will improve in like ratio." Let us hope so for the sake of the electric lighting industry in general, but it is, perhaps, a little too much to hope that the present evil of jerry wiring will cure itself. Not until the matter has been taken up by the proper authorities, and the insurance companies placed in a strong enough position to insist upon proper wiring, and competent inspection and supervision is provided during the progress of the work without running the risk of the insurance being placed elsewhere, can we expect any deviation from the inevitable tendency of the age towards cheapness, irrespective of quality.

Rules and regulations by scientific authorities are no doubt interesting, but in the absence of the means of enforcing them, they are to all intents and purposes useless for the purposes of raising the character of electric wiring in general.

From my experience of wiring I am led to the conclusion that no system that has yet been devised can be said to be universally satisfactory, nor is it likely that any one system could ever be devised that would comply with the exigencies of the very various conditions in which electric wires have to be run for light and power. The system of running wires should be designed with special reference to the fact that we are dealing with a perishable article in insulated wires, and that the two essential features, before which all other considerations should give way, are (1) that the sub-division of the circuits should be carried to such an extent as to prevent anything like a dangerous amount of current from getting out of bounds without the fact being notified by the blowing of a fuse or otherwise; (2) that the conduits should be so designed as to facilitate as far as possible the renewal of any wires or circuit which shows signs of sufficient deterioration.

If these conditions are properly and consistently carried out, periodic testing will do the rest, and there should not be any fear of hidden evils which unexpectedly could produce serious results.

We cannot expect to arrive at perfection, but it is always possible to do one's best.

Ed. C. de Segundo, A.M.I.C.E.

London.

Compulsory Purchase of Electrical Undertakings.

In your last issue I see an interesting article on the subject of compulsory purchase of electrical undertakings which leads me to mention a point with regard to Section 2 of the Electric Lighting Act of 1888, which I venture to think is of considerable importance.

I believe the opinion is generally held, whether erroneously or not I do not know, that under the said section a local authority has no power to purchase any portion of an electric lighting undertaking outside its jurisdiction, even though such portion be used for the purpose of generating electric energy for, and delivering it to, the area within its jurisdiction.

In your report of the proceedings before the Joint Committee on Municipal Trading, Sir L. Lyell appears to have asked Sir Courtenay Boyle the following question:—

When a municipality buys out an electrical undertaking which is partly within and partly without its own area, what becomes of the statutory right of a local authority to purchase the undertaking outside the municipal area?

Sir Courtenay Boyle is reported to have replied:—

It is not destroyed.

The question and answer would seem to imply the existence of the right of a local authority to purchase the portion of an electric lighting undertaking outside its jurisdiction. It must be a matter of considerable importance to local authorities in the metropolis whether such right exists.

Several legal gentlemen with whom I had the pleasure of discussing the matter seemed to think that it did not.

Such a power was conferred on the City Corporation by a special clause in the City of London Electric Lighting Order, 1899, as regards the undertaking under that particular Order, but I have not seen a similar clause in any other Electric Lighting Order.

Supposing that Section 2 of the Electric Lighting Act of 1888 does not give a legal authority any compulsory power to purchase the undertaking outside its jurisdiction, it is interesting to consider the terms of that section as affecting the position of such authority when it comes to exercise its powers of purchase as to the undertaking within its jurisdiction. The words in the section to which I would call special attention relate to the determination of the value of the undertaking, and, as I understand them, an arbitrator would be bound, in determining such value, to pay due regard, where a part only of the undertaking is purchased, to any loss occasioned by severance.

Now if you sever the mains within the area of supply from the generating station outside the area of supply, the latter may be rendered useless, whereas the former would probably be little damaged by the severance. Therefore, the local authority might be obliged to pay a large sum for damage in respect of the generating station, although it could not compel the undertakers to sell it to them.

It seems to me a question of great interest whether Section 2 of the Electric Lighting Act of 1888 does or does not involve this ridiculous conclusion.

Another interesting question is whether a local authority is empowered by the section to purchase any portion of an undertaking within its jurisdiction which is used for supplying an area outside its jurisdiction?

It would be satisfactory to know that the Board of Trade had sufficient powers to smooth over the many difficulties that, at any rate in the case of London, appear likely to arise with regard to the purchase of electric lighting undertakings under Section 2 of the Electric Lighting Act of 1888, but I do not find anything in the Act to support such a view.

A. A. Voysey.

Public Health Department,
Electrical Laboratory, Guildhall, E.C.
May 29th, 1900.

THE FUTURE DEVELOPMENT OF THE STEAM ENGINE.

So cautious a writer as Mr. A. Saxon, of Manchester, ought to command attention when he ventures to forecast events. We assume he is cautious, because, in speaking of the future development of the steam engine before the Manchester Association of Engineers, he left his hearers to decide for themselves whether 1900 A.D. was the first or last year of a century. He points out that in the past the direction of progress in locomotive, marine, and stationary work, has been along the same lines of higher pressures, greater expansion, provision for drier steam, higher piston speeds, &c.

There have also been improvements in shop methods, and in the materials of construction available that have assisted in the general effort for economy.

Up to 1870 steam pressures rose steadily but very slowly to about 75 lbs., since which time the rise has been rapid, and may, of course, be traced to the use of steel, and the improvements in its manufacture, that have rendered it a reliable material.

In a few cases pressures have reached 300 lbs. per square inch.

Mr. Saxon quotes a boiler maker of two or three years prior to 1873, who shook his head at a suggested pressure of 100 lbs., but finally produced a specification acceptable for that pressure.

As regards piston speeds, we are told that locomotives run at 750 to 1,500 feet per minute; marine practice runs from 425 to 1,200 feet in the smaller boats, while stationary practice varies from 500 to 1,000 feet, to which rate, we may add, it had closely approximated 20 years ago. The Glasgow Tramway engines are to run at only 750 feet.

As regards economy, the gain has been considerable, from 8 or 9 lbs. of coal per I H.P.-hour to as little as 1½ lbs. We wonder how much of this economy has been realised in electric traction work. There are engines using 10 to 12 lbs. per KW.-hour, and even more. The call to-day is not so much for engines capable of great economy, as some means for securing the economy of which the engine is capable.

Traction work is very disappointing to the steam engineer, because the variable load tells so heavily against economy. In view of our failures to secure the economy an engine is capable of, it seems a little premature to forecast pressures of 500 lbs. per square inch or

even higher. Such a forecast rather denies the caution we had credited to the prophet. Greater expansion must obviously follow on higher pressure, but we are informed, with probable accuracy, that four cylinders should suffice for this.

We note that Mr. Saxon still believes that with forced lubrication the high speed double acting engine may be employed up to 1,500 feet of piston speed in ordinary practice. The type of engine is to be the vertical inverted direct acting, and it will be a large engine; small engines as well as moderately big engines at low pressures will be discarded.

He declares the Lancashire boiler to be unsuited for pressures above 200 lbs., though he does not give reasons for the assertion. Superheating will be employed. This we do not doubt, but we think the amount of superheat will be moderate, because we believe that the engine of the future is very likely to be not Mr. Saxon's ideal engine at all, but simply an engine with only one cylinder, and without any of the evil effects which condensation in the cylinder brings about, and which so soon put a stop on the benefits of high pressures and greater expansions. There will be no such condensation in the engine of the future if, as seems to-day most probable, the engine is a steam turbine. Curiously, the lecturer, who has tried to foresee so much, has not named the turbine very favourably, and his paper presents no evidence to show it has even seriously interrupted his thoughts. Yet to-day it is claimed that the steam turbine holds the record for production of KW.-hours per pound of steam, and if the steam turbine could be built in a continuously curved conoid in place of the stepped diameters that the exigencies of construction render necessary or desirable in the interests of costs of manufacture, we believe it would take another big step forward. We omit here all reference to the gas engine, which will every year claim more and more attention. The steam locomotive, we are told, is doomed.

The marine engine has a formidable competitor in the steam turbine, but here, again, Mr. Saxon does not speak as from faith. Perhaps, however, it is asking too much from a reciprocating engine maker to love the steam turbine, but if we were engine makers we should get our patterns ready and a test engine running in our shops pending the time when the steam turbine becomes public property.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending May 30th, 1899.		Week Ending May 29th, 1900.	
Antwerp	Value £82	Amsterdam	Value £305
Auckland	146	Azores	86
Bombay	23	„ Teleg. apparatus	472
„ Teleg. mat.	22	„ Teleg. cable	329,000
Boulogne	27	„ Teleg. wire	1,153
Brisbane	287	Bangkok	85
Buenos Ayres	23	Barcelona. Teleg. mat.	340
„ Teleg. mat.	159	Bilbao. Teleg. cable	1,330
Calcutta	109	Bombay	40
Cape Town	10	Buenos Ayres	200
Copenhagen. Teleg. cable	330	„ Teleg. wire	339
Durban	2,050	Calcutta	204
Fremantle	28	Cape Town	153
Gothenburg	48	„ Teleg. mat.	4,103
Hamburg	140	Christchurch	11
Hong Kong	10	Copenhagen. Teleg. wire	279
Lyttleton	18	Durban	34
Mauritius	90	East London	94
Ostend	20	Gibraltar	110
Port Elizabeth	200	Gothenburg. Teleg. cable	23
Rotterdam. Teleg. mat.	290	Halifax. Teleg. paper	51
Shanghai	300	Hamburg. Teleg. mat.	35
Singapore	47	Hong Kong	641
St. Petersburg. Teleg. mat.	232	Lyttleton	145
Stockholm. Teleg. mat.	140	Melbourne	443
Sydney	190	Montreal	80
Trinidad	25	Nagasaki. Teleg. cable	4,700
Wellington	257	Port Elizabeth	100
Yokohama	51	Rio Janeiro	54
		St. Petersburg. Teleg. cable	157
		„ Telephone	41
		Shanghai	139
		„ Old teleg. wire	118
		Singapore	82
		Stockholm. Teleg. wire	428
		Sydney	499
		Wellington	68
		Yokoska	3,078
Total	£5,344	Total	£349,170

Foreign Goods Transhipped.

Brisbane. Teleph. appts.	Value £739	Tientsin. Teleg. mat.	Value £269
Wellington. Elec. lgt. „	72		
Total	£811		

Country House Pumping Plant.—A novel application of the electric current has just been made at Norbury Park, the seat of Mr. Leopold Salamons, for the joint services of domestic water supply and fire protection. One of the well-known "Hatfield" pumps has been provided to be driven by an electric motor, the special feature of which is that it is wound for running at two speeds without the insertion of a resistance for the low speed. Thus water may be delivered at a moderate rate for daily supply, and at a high speed for delivering powerful jets for fire extinguishing. The current being supplied from the accumulators the machinery may be put in action immediately on the discovery of a fire, and valuable time saved, and the water forced through fire-mains outside and inside the house. It is a curious fact that within a few days of the pump being installed a fire broke out in a flue and was promptly extinguished by the aid of the appliances. We learn from Messrs. Merryweather that the system of fire protection by electricity is becoming very popular amongst owners of country houses that are provided with the electric light.

Deed of Assignment.—In the matter of a Deed of Assignment for the benefit of creditors executed on February 19th, 1900, by Matthew Henry Barber (trading as Donnison, Barber and Co.), of 10, Corporation Street, in the city of Manchester, and residing at Ash Villas, Alderley Edge, in the county of Chester, electrical engineer and contractor, the creditors who have not sent in their claims are required before June 14th next to send particulars of their debts or claims to the trustee, John Wilson, 37, Brown Street, Manchester.

Fire Tests.—The investigations undertaken by the British Fire Prevention Committee on Wednesday last week, comprised a test with two fire blinds, and a test with the so-called "Mack" partition. The test with the fire blinds was intended to demonstrate the protection that could be afforded to windows and doors facing property in which there is an outbreak of fire, and which may be only separated by a small area or alley. This test was of one half-hour's duration. The partition test was to show the fire resistance of a thin partition followed by the application of water, the test having a duration of one hour and a quarter, and the temperature ranging up to 2,000° F. There was a large attendance of members and visitors at these tests, including many district surveyors and public officials.

Parliamentary Bills.—In the House of Commons on May 24th the following Bills were read a third time:—The Charing Cross and Strand Electricity Supply Bill, the Nottingham Corporation Bill, the South-Eastern Metropolitan Tramways Bill, and the South Lancashire Tramways Bill.

In the House of Lords on 25th ult. Royal assent was given by commission to the City and South London Railway Bill and the Charing Cross and Euston and Hampstead Railway Bill. The South Staffordshire Tramways Bill and the Mersey Railway Bill were read a third time. In the Commons the following Bills were read a third time: City of London Electric Lighting and London United Tramways.

The Pan-American Exposition.—Definite steps have been taken by the board of directors of the Pan-American Exposition Company to secure a supply of Niagara electricity for the power and lighting service on the Exposition grounds during the period of the Exposition. The directors have authorised Director-General Buchanan to conclude with the Niagara Falls Power Company and the Cataract Power and Conduit Company contracts for 5,000 H.P. at the grounds. Under these contracts the Niagara Falls Power Company, owners of the big generating plant at Niagara Falls, will furnish 5,000 H.P. at the terminal station of the Cataract Power and Conduit Company, distributing agents for Niagara power in Buffalo. This power will have an approximate voltage of 20,000, and will be ready for delivery April 1st, 1901. The service will be continued continuously from April 1st to December 1st, 1901. The price will be $25 per horse-power, the rental to be paid monthly, and the power to be measured at the terminal station above referred to. The Exposition is to furnish all transforming machinery, or other apparatus, subject to the approval of the electrical director of the power company, previous to its installation and use. The Cataract Power and Conduit Company is to take the power to be delivered by the Niagara Falls Power Company at approximately 20,000 volts, and will furnish and maintain machinery and transforming devices necessary to reduce the voltage to 11,000 volts, and is to construct a station for that purpose. The power will be transmitted from the terminal station of the Cataract Power and Conduit Company to the Exposition grounds on a pole line. In a transforming station to be erected on the Exposition grounds the voltage will be stepped down to 2,200, and will then go to 200 transformer pits, which will be built about the grounds. In these pits it will be again stepped down to 104 and 208 volts respectively, the lesser voltage being for lighting purposes and the higher for running pumps and machinery. While the main power supply of the Exposition will be electricity, there will be steam power, water power, natural gas and compressed air furnished on the Exposition grounds. This is owing to the fact that there will be exhibits that can be operated only by water-power, others that will require compressed air, &c., and the management intend that all classes of power shall be available. The board of directors has authorised the Director-General to contract for or lease all material, equipment and apparatus which will be required in connection with the development and utilisation of such power and light within the grounds.

Pigeon Post.—The Mafeking garrison found pigeon post a most valuable method of sending messages to the outside world during the seige, and it had been suggested that Ladysmith and Kimberley would have been considerably better off if they, too, had kept a number of these winged messengers available. An effort is being made to educate the public in the great service which these express service birds can render. The effort is being enthusiastically pushed by Mr. Wm. McGregor, the founder of the British Volunteer Pigeon Post Association. Mr. McGregor knows something of the subject, for he has spent 28 years in the Indian Telegraph service, latterly as superintendent of Government telegraphs at Assam. One point which is more within our scope than the general question is the use of carrier pigeons at telegraph stations for despatch immediately a breakdown occurs

thus effecting a saving of time and perhaps risk, and facilitating the re-establishment of communication. There has recently been a conference held at the Crystal Palace, where some trained pigeons are now to be seen, and at the Army and Navy Exhibition now being held at the Aquarium in London there is an exhibition of a number of the birds, with their aluminium carriers. We understand that a report of the experiments made under the auspices of the Association mentioned is to be submitted to the Marquis of Lansdowne. We are also informed by Mr. McGregor that there are now as many as 500,000 trained carrier pigeons which can be placed at the disposal of the Government if required.

Books Received.—No. 37, "Fire Tests with Partitions"; No. 49, "Fire Tests with Doors." London: The British Fire Prevention Committee. 2s. 6d. each.

"Leçons d'Electrotechnique Generale," by P. Janet. Paris: Gauthier-Villars, 1900. 20 fr.

"Handbook of Electrical Testing," by H. R. Kempe. London: E. & F. N. Spon, Limited, 1900. 18s.

Catalogues and Lists.—Messrs. A. & J. Smith, of Aberdeen, send us a pamphlet relating to their non-magnetic watches.

Messrs. D. H. Bonnella & Son, Limited, send us a copy of Section F. of their catalogue in which are detailed and fully illustrated a large variety of electric light fixtures.

Messrs. Arthur Cort & Co., London, are circulating a wholesale price list of Balata gutta-percha and cotton belts.

An abridged illustrated catalogue of machine tools has been brought out by Messrs. Geo. Richards & Co., Limited, of Broadheath. Planing, drilling, boring, band sawing, and other machines, air compressors, pulleys, shafting, &c., are well illustrated, and some descriptive particulars given.

Electric Lift.—An Otis electric lift has been completed at the new offices of the *Financial Times*, 72, Coleman Street, E.C.

The Glasgow Exhibition.—Messrs. Walter Macfarlane and Co. are to loan to the International Exhibition 54 electric light pillars for the purpose of lighting up the grounds. At the end of the Exhibition the Corporation are to take over these pillars at a price to be mutually arranged.

Dissolution.—Messrs. W. Scholes, J. Whitehead, and J. E. Shore (Scholes & Son, Manchester, and J. Whitehead & Son, Middleton), electrical and mechanical engineers, &c., have dissolved partnership. Debts will be attended to by W. Scholes who carries on the businesses as Scholes & Son.

Smoke Nuisance.—The Guildford Electricity Supply Company was last week fined £2 and costs for not abating a nuisance caused by smoke emitted from their chimneys, in accordance with an order made on January 8th.

Theft.—A labourer named Scott was sentenced at Glasgow last week to 30 days' imprisonment for climbing a telephone pole and stealing 230 yards of copper telephone wire. The trunk line between Glasgow and Paisley was interrupted for a considerable time in consequence of Scott's action.

Trade Announcements.—Messrs. Laidlaw, Scholes and Co., electrical engineers, have removed from Temple Street, C. on M., to more commodious premises at Blantyre Street, Chester Road, Manchester.

The firm of Honeywood, Austin & Co., mechanical engineers, &c., of Harleyford Road, Vauxhall, having undergone certain alterations, the name of the firm will in future be Dick & Honeywood.

ELECTRIC LIGHT AND POWER NOTES.

Abercarn.—In view of the South Wales Electrical Power Distribution Bill now before Parliament, the Abercarn District Council (which is opposing the Bill), at a special meeting last week, resolved:—"That a committee of this Council be appointed to consider the whole question of the public lighting of the district, including the advisability or otherwise of the Council undertaking to provide a system of electric light within the Council's area, or the advisability of joining with local authorities to provide an electric scheme for the Western Valleys of Monmouthshire."

Arbroath.—A meeting of the Arbroath Gas Corporation was held in the Town Hall last week, Provost Grant in the chair. With regard to carrying out the electric light undertaking for the town, the Special Committee reported that they had received a letter from Messrs. Buchan and Hogarth stating that the preliminary fee for making a report would be 50 guineas, plus expenses, these latter not to exceed £10. If, subsequently, the Corporation agreed to retain the firm as engineers, the fee would be the ordinary 5 per cent. on the cost, less 50 guineas, the preliminary fee, but plus expenses, the latter in this case not to exceed £50. The Electric Lighting Committee recommended that this offer should be accepted. Ex-Provost Keith moved the adoption of this report, which was then agreed to. Some discussion took place as to whether Mr. Buchan as an individual or Messrs. Buchan and Hogarth as a firm, should be recognised as consulting engineer or engineers to the Board. Ultimately, after a great deal of talk, it was resolved to recognise Mr. Buchan as the consulting engineer.

Aldershot.—The Town Council is inviting tenders for a 6,000-lamp installation, with a view to forming a definite decision on the matter. If one of the tenders is accepted, a resident engineer will be appointed to carry out the undertaking.

Bath.—The high price of coal prevents the Electric Light Committee from reducing its charge for electric current. At last Thursday's meeting of the Committee Mr. Bush raised the question of the proposed reduction in the price of current to 4½d. per unit on June 24th. If they carried that resolution out he said that he should want two or three months' holiday to get out of the way of the people, because the price of coal had so vastly increased, that the loss would be great. The coal bill before them was for £178 17s. 4d., an increase as compared with last year of £60, or 33 per cent. Mr. Bush: If we insist on that reduction I shall get out of the Committee, because I am afraid of it. The Chairman: I do not think anybody would stay on it. He thought consumers should be charged 4½d., and all the extra cost to the Committee, owing to the increase in the price of coal. Mr. Metzger read advices from the last contractors, a large Welsh firm, which stated that coal would be no cheaper this year than it was now. Belgium and Germany for the first time were taking 2½ out of the six million tons output of small coal produced. In consequence coal, which last year was 14s., was now 25s. Mr. Knight said it was clear the circumstances did justify them in giving notice to rescind their resolution to reduce the price of current in June. It was eventually resolved to suspend the reduction till such time as the Committee felt the price of coal warranted it.

Beckenham.—The District Council is proposing to spend £7,000 in the electric wiring of houses.

Birmingham.—The Electric Supply Committee of the City Council, reporting on the taking over of the electric lighting undertaking, stated recently that the gross profit for the year ending December 31st last was £23,490, an increase of £5,963 over the preceding year. The reserve fund amounts to £25,856. During the year the output was 2,252,692 units, an increase of 30 8 per cent. over the previous year, and the total number of lamps connected was 62,705 (16-c.p. equivalent). The gross revenue was £43,246, an increase of 29 2 per cent. Considerable extensions of the works are already in hand for next winter's load.

Buxton.—The electricity works belonging to the Urban District Council have now been opened, and the supply of electricity laid on for street lighting and private consumers. In 1898, Prof. Kennedy was consulted by the Council and recommended the adoption of a continuous current three-wire system at 230 volts, which was adopted by the Council. There are three water-tube boilers by R. Hornsby & Sons, Grantham, equipped with mechanical stokers and working at 160 lbs. pressure. Worthington feed pumps are used. There are four high speed double-acting engines by Belliss & Morcom, coupled to Mather & Platt dynamos. The two batteries of accumulators consist of 130 cells each, with a discharge capacity of 250 ampere-hours. The boosters are by Thos. Parker, Limited, and the travelling crane by Higginbottom & Mannock. The engines, dynamos, feed pumps, and crane were supplied under the contract of Mather and Platt. The switchboard was manufactured by Mr. James White, of Glasgow, who also supplied the booster. The feeders and distributing mains are of the concentric type; all the cables are lead-covered and armoured, supplied and laid by Callender's Cable and Construction Company. The present amount of feeder laid is about one mile and three quarters, and the distribution about 5 miles. Prof. Kennedy was represented by Mr. Kenneth Watson, who superintended the erection of the machinery. Mr. Edward Calvert is the electrical engineer appointed by the District Council. The machinery, feeders, mains, arc lamps and posts have entailed an outlay of over £14,000, the buildings nearly £5,000, miscellaneous expenses £2,000. The original loan was £24,769.

Cardiff.—Mr. Appelbee, the electrical engineer, has interpreted the Council's recent resolution giving him complete control over the electricity works staff, as giving him financial powers as well, for he has, to the Council's dissatisfaction, increased the wages of four members of his staff, one by 5s. per week and three by 10s. each. It seems that the Lighting Committee had on two occasions declined to grant applications made by one of these men for an advance, and this fact doubtless went a long way toward inclining the Committee to take umbrage at his action. Mr. Appelbee declares—and in this we do not doubt he is perfectly correct, for central station assistants are too often badly remunerated—that the men are fully worth the increased rate, and have been previously underpaid. The opinion of some members of the Committee was that Mr. Appelbee should have reported to the Committee that these increases were merited before actually granting them, and others, while regretting the action, thought the engineer had been thoroughly honest in his misconception of his powers. One speaker thought they could not do other than endorse the past action of the engineer, or they would be humiliating him and jeopardising the works' discipline. Eventually Councillor Fox proposed, and Councillor Good seconded, that the increased payments to the four men cited be suspended, and that the Committee consider any applications made by the men and submitted by the electrical engineer. Alderman Ramsdale moved an amendment to the effect that after the explanation of the engineer and under the circumstances the action of the engineer in increasing these particular salaries be endorsed, but that for the future all applications for increases in salaries be presented to that Committee. The amendment was carried. The question of raising

the salaries of the deputy engineer and the works' superintendent then came up, and after a little discussion the matter was deferred for a month.

The Town Council has been for some time considering the advisability of putting down a direct current plant in place of the additional high-pressure alternating current machinery proposed in April last. The electrical engineer, Mr. Appelbee, submitted a report on the matter, and a special meeting was to be held to deal with the whole question.

Chicago.—The lighting of Chicago and suburbs is carried on by two companies, the Edison Company, and the Commonwealth Electric Company, which furnishes current for the outlying districts. Both companies are controlled by the same interests, and both properties are under the same management. Distinct organisations are maintained, however, and the several plants are authorised and the services performed under separate ordinances. The Chicago Company has four generating plants, a former generating station now doing duty as a battery plant. The following gives the capacity of the four stations:—

Station.	Nominal boiler H.P.	Engine H.P.	Generator. KW.	Rotaries. KW.
Number 1	5,150	9,600	6,400	250
„ 2	1,650	1,250	1,000	850
„ 4	1,375	825	550	200
„ 5	4,960	6,950	5,360	250
	13,135	18,625	13,310	1,550

Equivalent in 8 C.P. lamps 1,188,464.

The Commonwealth Company has four stations, as follows:—

Station.	Nominal boiler H.P.	Engine H.P.	Generator KW.
A.	700	1,580	655 arc 610 incan.
B.	650	775	430 arc 170 incan.
C.	800	820	660
D.	900	900	640
	3,050	4,025	3,165

Total equivalent in 8 C.P., 357,900.

Edinburgh.—In proposing an increased charge from 3½d. to 3⅝d. per unit., Bailie Mackenzie last week informed the Town Council that the necessitating circumstances were the great rise in the price of coal and the large expenditure on their new undertaking. Even with the proposed increase, the charge was still about the lowest in the kingdom, there being only about four places where the average price was a shade under 3½d. per unit. The estimated production for the coming year was 7,300,000 units for private consumers and public lighting. The number of lamps actually joined on during the year was 69 832, the biggest that ever this undertaking, or, he believed, any, had connected in one year, and over 2,000 more than Glasgow.

Gloucester.—Mr. R. H. Bicknell, M.I.C.E., held a Local Government Board inquiry at Gloucester on the 25th ult. with reference to an application by the Town Council for sanction to borrow £9,425 for purposes of electric lighting. The town clerk said that the Council had spent the original loan of £43,450, and the loan now asked for was for an extension of the plant, &c. Mr. R Hammond gave details of the proposed extension, and said that the demand had been so great, although the works had not yet commenced supply, that it was certain that the load next winter would considerably exceed the safe working capacity of the initial plant. Up to the present 135 applications, for 13,350 lights, had been received—a demand that would slightly overload the present plant. This position completely justified the Council in its decision to lay down another 300-KW. set. This would bring up the total effective capacity to 600 KW. (allowing 300 KW. as a reserve) which was capable of dealing with a demand of 30,000 lamps connected. The experience of Gloucester had been identical with that of Canterbury, where by diligent canvassing they had absolutely filled up the whole of their plant before turning on the current, and the cost of generation for the first 12 months was 1·85d., the exact value he had indicated as probable in the case of Gloucester 12 months before. Mr. Hammond further stated that, in his opinion, within five years the plant would have to be made three times as large.

Gosforth.—The Newcastle-on-Tyne Electric Supply Company have, through Messrs. Dyson & Co., Parliamentary agents, lodged a petition at the Private Bill Office of the House of Commons against the Gosforth Electric Lighting Order.

Greenock.—The number of lamps applied for up to the present by private consumers is equivalent to 6,258 8-C.P. lamps, and this, with the arc lamps, brings the total up to 7,152, or an increase of 710 8-C.P. lamps since last month's report. The number of consumers is 97.

Hastings.—The Electricity Committee has appointed Mr. Charles Dadding, at present one of the assistant engineers at Yarmouth, to fill the vacancy recently advertised. There were 95 applications for the post.

Hull.—The Lighting Committee reports that the seventh years' working of the electricity undertaking has resulted as follows:—Gross receipts, £19,290; expenditure, £10,631, leaving a gross profit of £8,659. The net profit, after all deductions, amounted to £1,924. At the end of the financial year (March 31st last) there were 1,326 consumers connected, taking 940,192 units, as against 960 consumers and 749,690 units in the previous year; 54 motors are supplied, the largest being of 35 H.P., and a 50-H.P. motor is about to be connected. The total capital expenditure to date is £133,802; two 800-H.P. generating sets were installed during last year, and two more are to be added this year.

Heckmondwike.—The District Council has accepted tenders for the electricity undertaking to the amount of £8,535, out of a total of £14,342.

Horsham.—The District Council is making application to the Local Government Board for sanction to borrow £15,000 for electricity supply works.

Inverness.—A special meeting of the Town Council took place last week to consider the relationship between the Council and the electrical engineer, Mr. Craven. After discussion, a resolution was adopted to the effect that the whole of the specifications, estimates, correspondence, and analysis of separate offers submitted to a recent meeting be submitted to an engineer of known standing, to be chosen by the Council, with instructions to report on the whole scheme.

Kilmarnock.—We learn that great alterations and improvements are being carried out at Caprington Castle, Kilmarnock, the property of Colonel Smith-Cuninghame, who is at present in command of the 2nd Life Guards, in the absence of Colonel Neeld, in South Africa. Electric light is to be introduced into the Castle, and electrical motive power applied at the workshops at Earleston, which contain some machine tools of considerable size. Mr. Ed. C. de Segundo, A.M.I.C.E., is acting as consulting engineer.

Keighley.—Mr. W. A. Ducat, Local Government Board inspector, held an inquiry last week into an application by the Corporation for borrowing powers for £45,000 for electric lighting purposes. It was stated that the estimated expenditure included £31,460 on plant and buildings, £3,146 engineers' expenses and contingencies (10 per cent.), £9,122 cost of site, and £1,250 cost of first 12 months' running, making a total of £44,978.

Killarney.—At the Killarney Petty Sessions last week at the suit of the Killarney Urban Council, there were 28 summonses heard against the Killarney Electric Lighting Company, for failure for 28 days in keeping up the electric supply to the public lamps in the streets, for which the company are contractors. The defence put forward on behalf of the company was that the failure occurred through an inevitable accident, as one of the alternators broke down through some unaccountable reason. The Bench decided that there was neglect on the part of the company in not having duplicate plant, and imposed a fine of 5s. in each case, with 5s. costs also in each case.

Kirkcaldy.—The Tramway and Electric Lighting Committee has been considering the appointment of an engineer. Full inquiries are being made to this end.

Leeds.—At the last meeting of the City Council a resolution of the Lighting Committee was adopted, which recommended that advertisements be published inviting tenders for the supply of two or three 1,000-H.P. sets of two-phase alternators, and that a quotation be obtained for the supply of a 1,000 H.P. Babcock and Wilcox boiler, to replace the old 100 KW. engines and dynamos. The Sub-Lighting Committee met on Monday to open the tenders received, which numbered 18. These were to be laid before the full Committee on Wednesday.

London.—WHITECHAPEL.—At the meeting of the District Board of Works last week the chairman reported progress with regard to the electric lighting installation. Up to the present time, the expenditure of the Board had amounted to £56,480, and they had received £7,650 17s. 4d. in respect to the installation. They were supplying 4,508 8-C.P. in addition to the street arc lights, and they had received far more applications for installations than they could supply with their present machinery.

MILE END.—The *Contract Journal* says that a Special Committee on the electric lighting question of the Mile End Guardians have reported that Mr. Knight has informed them that "the boilers were wrong, the installation was wrong, and the cells were wrong, that the engines should be fast ones instead of slow ones, and that in regard to cost £3,000 would put the service in good working order, excepting the provision of storing rooms; that three boilers would cost £1,800, and the total cost would be £6,000." The Committee visited the boiler house, the works generally, and saw the master of the workhouse and the engineer in reference to the quality of the coal. The Committee further reported that in 1895 the cost of the coal bill was £585 1s. 3d., and labour £215 16s.; at Lady Day, 1900, it was as follows: coal £2,298, and labour £508. It was proposed to reorganise the engineering staff. The report was referred back.

ST. PANCRAS.—The Vestry has reduced the charges for current for churches and chapels.

ISLINGTON.—At the Vestry meeting last week Mr. Gordon moved the adoption of the report of the Electric Lighting Committee, which stated that they had considered the letter from the clerk to the London County Council dated March 9th, 1900, in reply to the Vestry's letter of the 19th ult., in which they declined to accept the provisional sanctions of the Council to the borrowing of £10,000 and £38,000 respectively on account of the above-named loans. The matter had been very carefully reconsidered by the Finance Committee of the Council, which was unable to take any further steps until the Vestry had supplied the details and information for which it had been asked, and the Committee was of opinion

that the Council would not be performing the duty imposed upon them by Parliament if they sanctioned the borrowing by local authorities on estimates and opinions furnished by such authorities without being satisfied from the reports of their own officers that the amounts proposed to be borrowed were reasonable. They recommended that application be again made to the Council for their sanction to the borrowing by the Vestry of the sums of £13,200 and £56,261, and that they be requested to specifically state what further particulars they required. After a good deal of discussion Mr. Mills moved an amendment that they should ask the Finance Committee of the London County Council to receive a deputation in order to obtain the sanction that was desired. The amendment was carried by 40 votes against 31; the interview duly took place, with the result set forth below.

London County Council.—The Council, at the meeting on Tuesday, resolved to lend £20,000 to the Battersea Vestry for electric lighting purposes, and £6,000 to the St. Martin's Vestry to defray the cost of providing lamps and standards in connection with the arc lighting of the streets. The Finance Committee reminded the Council of the report presented in March last on the application of the Islington Vestry for sanction to borrow £56,261 and £13,200 for electric lighting purposes, when the Committee were unable to recommend permission to raise more than £38,000 and £10,000 respectively owing to the inability to obtain from the Vestry certain details and information. In this connection the Committee stated they had now had an interview with a deputation from the Vestry, and had been furnished with explanations which enabled them to suggest that sanction should be given to the borrowing of the balances. The Committee accordingly submitted recommendations sanctioning the borrowing by the Vestry of £18,261 and £3,200.

Mr. Elliott (Islington) said that the Committee had at first refused to grant the totals of the loans required by the Vestry. A deputation from the Vestry had waited upon the Committee the other day in order that one body should not go to law with the other in regard to the items, and they had resolved to give the Vestry what was required. The Vestry had said that if the Council would not sanction the money, it would apply to the Queen's Bench Division for a mandamus for the Council to grant the money, and the Council had hauled down its flag again. That was the result of Islington approaching the Council in a conciliatory manner, with the desire of saving the public money in law and litigation.

Mr. Torrance protested against the language used by the previous speaker. The deputation came before the Finance Committee and received a patient hearing and gave certain information which the Council desired, resulting in the present recommendation of the Committee.

Mr. Cohen, M.P., submitted that the difference between the Council and the Vestry would not have existed if it had not been for the manner in which the correspondence had been conducted. The difference, however, disappeared when Mr. Mills came and expressed his willingness to do what the Council had always asked the Vestry to do. The speaker shared the regret of the Vice-Chairman of the Council at the inappropriate moment chosen to re-open the wound.

The recommendation of the Committee was then put and carried.

East End.—The Board of Trade intends to treat the electric lighting undertakings of Limehouse, Mile End, and St. George's, for which provisional orders have been issued, as one with that of Whitechapel when the new borough of Stepney is established.

Marylebone.—The report of the Highways Committee reminded the London County Council on Tuesday that the Board of Trade, in granting a provisional order to the Marylebone Electric Supply Company, had not adopted the suggestion made by the Council that the maximum price to be charged under the order should be 5d. per unit. The Committee mentioned that they had been in communication with the Board on that point, and, in reply, the Board stated that they did not consider it expedient that a lower maximum price than 6d. per unit should be prescribed at present, but that they proposed to amend Clause 32 of the order so as to enable the Council, at any time after the commencement of the order, to make a representation to the Board that the maximum price should be altered. This amendment, the Committee concluded, would have the effect of preventing unreasonable charges being made.

The Vestry last week resolved to petition Parliament against the Bill for the confirmation of the provisional order of the Marylebone Electric Supply Company, and to invite other authorities in the metropolis to take joint action in opposing the Bill. It was also decided to make representation to the Board of Trade that the prices and method of charge by the Metropolitan Electric Supply Company in the parish should be altered.

Plumstead.—The Lighting Committee of the Vestry has recommended a scheme estimated to cost £40,000, and capable of supplying 18,000 lamps. A deputation from the Vestry is to visit St. Helens and Darwen to view the dust destructors at those places, which are worked in conjunction with the electricity works.

Lowestoft.—The walls of the municipal electricity works have shown grave signs of disturbance, due to pumping operations connected with the excavations for engine beds. Mr. Hawtayne, the consulting electrical engineer, has suggested that a concrete raft be formed to support the engines, and that buttresses be built to strengthen the outer walls.

Lymington.—The Town Council has accepted a tender by the Electric Light and Power Company for lighting the streets with electricity for a term of five years. It is claimed by the company that they will give double the light for less than the price now paid for gas.

Maidstone.—Colonel W. R. Slacke, R.E., held an inquiry last week, on behalf of the Local Government Board, into the application of the Urban District Council for powers to borrow £40,000, for the purpose of providing an electric light supply for the town.

Middlesex.—The Board of Trade having struck out certain protective clauses relating to the control of main roads, from the provisional orders issued for the Twickenham and Uxbridge electricity supply schemes, the County Council will oppose the confirmatory Bills with a view to obtaining the re-insertion of these clauses.

St. Annes.—A Local Government Board inquiry was held last week regarding the Council's proposal to alter the site of the new electricity works. Practically the whole of the cables have been laid, and the Council is eager to hurry forward with the erection of the works.

Sheffield.—As illustrating the effect of the increased cost of materials on electricity undertakings, we note that at Sheffield, where five years ago the Electric Light Company paid £1,450 per marine boiler, the Corporation now has to pay £2,850 each for what are stated to be boilers of exactly the same type and size. Eighteen months ago the price was £1,950, but since then the rate of increase has been considerably greater.

Trafford Park.—It is hoped that within a very short time the power house, for which Messrs. Lacey, Clirehugh and Sillar are consultants, will be ready for the distribution of current for power and lighting purposes.

West Ham.—The Council last week decided to insure the electricity works for one year with the Norwich Union Fire Office at 5s. per cent. Several members protested that the place did not need insuring.

West Riding.—A syndicate, to be known as the Yorkshire Electric Power Company, is promoting a scheme for the supply of electricity to the manufacturing districts of Yorkshire on the lines of the Lancashire project.

Yeadon.—The District Council has decided to ask the Board of Trade to extend the time of the provisional order, and also to ask the Leeds City Council if it is prepared to supply electricity in bulk to Yeadon in conjunction with the proposed tramway scheme.

ELECTRIC TRACTION NOTES.

"American Street Railway Investments, 1900."—New York: *Street Railway Journal* Office.—The edition of this work for 1900 will be of service to all interested in the management of electric street railways. One is frequently reminded of the fact that in the States there are so many thousand miles of electrically operated line, and here we have the particulars of the many companies by which these are worked, and the financial results which have attended their operation during the past few years. Altogether there are contained in this book, which is called the "Red" book, presumably to distinguish it from some rival publication, 1,252 reports of street railway companies, over 80 per cent. of which have been examined and officially "approved" by the companies themselves before publication in this work. We especially note a valuable table showing comparatively the gross receipts of the 222 systems in the years 1898 and 1899. There was a general average increase last year of 7·82 per cent. Twenty-five of these properties had gross receipts of over $1,000,000 in 1899, and 18 were between $500,000 and $1,000,000. Operating expenses, statistics of traffic, brief outline of the system of traction, names of directors, and so forth, are among the information here embodied. There are 289 pages of reading matter and 25 maps of the principal street railways.

Birmingham.—The Public Works Committee has been going into the question as to which form of overhead construction shall be adopted by the tramway company for the Bristol Road section, which is to be converted to electric trolley.

Bournemouth.—The Bill to confirm a provisional order of the Board of Trade with respect to tramways in Bournemouth will be opposed in committee by the Poole and District Electric Traction Company.

Bray.—A syndicate has been formed to construct the Bray and Enniskerry electric railway.

The City and South London Railway.—Subject to the approval of Lieut.-Colonel Yorke, the inspector appointed by the Board of Trade to make the necessary official examination, the extension of the City and South London Electric Railway from Stockwell to Clapham Common will be opened to the public at noon on Whit Sunday. An intermediate station has been placed quite close to that of the South-Eastern and Chatham Company in Clapham Road, and there, as also at the terminal station fronting Clapham Common, the electric railway is approached from the road level by two capacious lifts. On week-days there will be a train service to and from Moorgate Street every three or four minutes, and on Sundays every five or six minutes. The line is now being carried from Moorgate Street to Islington, and this extension—to be completed early next year—will establish a direct connection underground between North and South London.

Greenock.—The terms of agreement for leasing the tramways of Greenock to the Port Glasgow Tramways Company were before the Police Board last week, and it was decided to hold a special meeting to discuss the matter. The lease is from May, 1900, to May, 1928 the company to equip all lines for overhead trolley

running by May, 1901; to pay £1,200 per annum as rent and £450 per annum for street maintenance, repairs, &c.; electrical energy to be taken from the Police Board's electricity works, the company paying 1½d. per unit for a minimum supply of 500,000 units per annum.

Light Railway Applications.—Notices appear in the *London Gazette* for May 29th of the following applications which are to be made for light railway orders:—

Pwllheli-Nevin: North Wales and District Light Railway and Electric Power Syndicate.
Blackburn, Whalley and Burnley District: Auxiliary and Light Railways and Tramways Company, Victoria Street, S.W.
Staines and Egham: Staines and Egham Light Railway Company.
Warrington and Runcorn: International Electric Traction and Power Syndicate, Tower Chambers, Brown Street, Manchester.
Nidd Valley: Power and Traction, Limited.
Cleobury, Mortimer and Ditton Priors: Viscount Boyne and Admiral Robert Woodward.
Sheerness and District: British Electric Traction Company.
Wales and Laughton: T. R. Gainsford, C. E. Jeffock, and A. Wightman.
Kingston, Surbiton and District: British Electric Traction Company, Limited.
Jarrow and South Shields: British Electric Traction Company.
Swansea and District: Mayor and Corporation.
Durham and District: British Electric Traction Company.
Bath and District: Corporation.
Barnsley and District: British Electric Traction Company.
Mansfield and District (Extensions): J. Fell, J. Lewis, W. J. Kershaw and others.
Warrington and Northwich: A. Anderson, A. Brown.
Kidderminster and Bewdley: Kidderminster and District Electric Lighting and Traction Company.

Liverpool.—The Liverpool Overhead Railway Bill, which seeks power to enable the company to extend the line to Seaforth, has been withdrawn from the consideration of Lord Newton's Committee of the House of Lords, and will now proceed as an unopposed measure.

The electric car service to Bootle was commenced on 27th ult.

London.—The Extensions Bill promoted by the London United Tramways Company is to be opposed in Committee of the House of Lords by the Middlesex County Council, notwithstanding the fact that the local authorities affected by the Bill are in favour of the scheme, and have asked the County Council to abandon its opposition as being a waste of public money.

LONDON COUNTY COUNCIL.—The Council resolved on Tuesday, on the recommendation of the Highways Committee, to instruct the Parliamentary Committee to include in a Bill to be promoted in the next session a clause to confer upon the Council powers—

(1) To double the single line of tramways in those portions of (*a*) Battersea Park Road, (*b*) Bermondsey New Road, (*c*) York Road (Battersea and Wandsworth), (*d*) Albert Embankment, and (*e*) Wandsworth Road, in which the Council is effecting widenings under powers already conferred by Parliament; and (2) to construct a double line of tramways along the new street from Bermondsey New Road to Tooley Street, authorised by the Tower Bridge (Southern Approach) Act, 1895.

It was intended to reconstruct the tramways for an underground system of electric traction at an estimated cost of £57,?00.

The Parliamentary Committee reported that it would probably be advisable to present a petition to the House of Lords against the South Eastern Metropolitan (Electric) Tramways Bill, with a view to obtaining amendments which were considered necessary by the committee. On the recommendation of the committee, it was decided to seal a petition for presentation to the House of Lords if it should be found essential to do so. Before the adoption of the recommendation Mr. Benn stated, in reply to Mr. Boulnois, that the Council had no objection to the company's system being transformed from horse to electric traction, but as the Council would have to purchase the lines in 1910 they went to Parliament contending that regard should be had to the system which the Council proposed to introduce at an early date. The Council tried to get a *locus* on that point before the House of Commons Committee, and they intended to go to the House of Lords for the same reason. The Committee were not opposed to any of the companies altering their methods from horse to electric traction if they had regard to the system to be adopted by the Council.

Scarborough.—Messrs. Lacey, Clirehugh & Sillar have been appointed to report for the construction of the electrical trams from the top of the North Cliff to Clarence Drive.

Southampton.—Colonel Yorke, of the Board of Trade, has made the official inspection of the town section of the new municipal electric tramways.

York.—The City Council will meet on July 2nd to consider a resolution requiring the City of York Tramway Company to sell their undertaking.

TELEGRAPH AND TELEPHONE NOTES.

Dover Telephones.—A report has been submitted to the Corporation on the subject of a municipal telephone system, by Mr. A. R. Bennett (who, by the way, is stated by the *Dover Express* to be engineer to the Glasgow *tramways*). His estimate of the cost of an exchange, to include Dover and St. Margaret's, is given by the local paper mentioned, as follows:—

Considering all the facts, I estimate that £16 per line would be a liberal provision for a first-class metallic circuit telephone exchange system, constructed in accordance with the specification annexed by the Post Office to licenses to local authorities, within the contemplated Dover telephone area. Probably the cost would not exceed £15 a line. I was informed by Mr. Stilgoe, the borough engineer, that as a rule the telephone conduits could be laid under the footpaths and I am assuming that this would be the case. The spare partially completed lines would cost £8 each as a maximum. This works out:—

300 subscribers and 20 public telephone lines complete at £16	£5,121 0 0
150 partially completed lines at £8	1,200 0 0
	£6,320 0 0

TARIFFS.

An average receipt per working line of about £5 5s. per annum is necessary to place an exchange on a remunerative basis. Although I should expect that a reduction to an average of £5, or even £4 15s., per annum would be found possible after a short experience, it would not be judicious to rely upon less than an average of £5 5s. to begin with.

ESTIMATE OF REVENUE.

300 subscribers at £5 5s. average annual receipt	£1,575 0 0
20 public telephone call offices at an average receipt of 3s. per week	156 0 0
Extra mileage charges on lines exceeding one mile in length, say 10 miles at £2, say	20 0 0
Commission on value of messages telephoned to the Post Office for transmission as telephones, express letters, &c., say	7 10 0
	£1,758 10 0

ESTIMATE OF WORKING EXPENSES.

Manager and engineer at £3 per week	£156 0 0
Clerk and storekeeper at 30s.	78 0 0
One junior or lady clerk at 15s.	39 0 0
One boy at 10s. per week	26 0 0
Corporation establishment charges	50 0 0
Eight girl operators at 9s. per week average wage	187 4 0
Rent and rates of central switch-room and offices	50 0 0
Rent of small switch-room at St. Margaret's	15 0 0
Local assessments	8 0 0
Insurance, light, firing, water, cleaning	40 0 0
Stationery, printing, postage, office sundries	26 8 0
Way-leaves	50 0 0
Repairs at £2 per cent. on £5,120	103 8 0
Post Office Royalty 10 per cent. on £1,751	175 2 0
Interest on capital, 3 per cent. on £5,120	153 12 0
Sinking fund, 3 per cent. on £5,120. This, with interest on accumulations at 2½ per cent., will pay off the whole capital in 25 years	153 12 0
Depreciation and renewal fund, 2½ per cent. on £5,120 3 per cent. with interest on accumulations at 2½ per cent. would renew the whole system in 25 years. But the old material taken out would be worth at least ½ per cent., so that 2½ per cent. would renew the whole system in 25 years	128 0 0
Income-tax and sundries	60 0 0
Commission on public telephone receipts	13 0 0
Contingencies	50 0 0
	£1,560 18 0
Add on account of lines partly constructed—	
Interest on 3 per cent. on £1,200	36 0 0
Sinking fund at 3 per cent. on £1,200	36 0 0
	£1,632 18 0

Net revenue .. .. .. £125 12s. 0d.

It will be observed that not only is provision made for recovering the whole capital in 25 years, but for renewing the whole of the plant, so that at the termination of the license, the Corporation would be in possession of an efficient up-to-date system which would have cost them nothing. If this provision be deemed excessive then the amount saved from the depreciation and renewal fund, will be available towards a further reduction of rates.

The London County Council and the Telephone Service.—At Tuesday's meeting of the London County Council the report of the Highways Committee, which has been adjourned from time to time since March of last year, was again brought forward. The Committee recommended the Council to pass the following resolutions:—

(*a*) That, in the opinion of the Council, the telephone service in the London area of the National Telephone Company should be managed by the Council, the Corporation of the City of London, and the local authorities of districts outside the administrative County of London, but within the London telephone area; (*b*) that, in the opinion of the Council, application should be made to the Postmaster-General by the Council, the Corporation of the City of London, and the other local authorities of districts within the London telephone area of the National Telephone Company, for a license under the Telegraphs Act, 1892 for the establishment of a telephone service in respect of that area; (*c*) that the clerk of the Council do, in conjunction with the town clerk of the City of London, draft an application to the Postmaster-General for the license above referred to; and that such draft application, when prepared, be submitted to the Council for approval.

Mr. J. W. Benn, chairman of the Committee, asked permission of the Council to withdraw the recommendations. He did so because the Committee had every confidence in the proposals of Mr. Hanbury, and, for the time being, in the operations of the Postmaster-General. They had come to the conclusion that as London was to be under the dominion of the Government the telephone question could be left to the Government. If, however, that was unsatisfactory, the subject of the Council applying for a municipal license could still be considered, although he hoped the necessity for so doing would not arise.

The consent of the Council having been obtained, the recommendations were then withdrawn.

The Highways Committee recalled the fact that an action, brought by the Council against the National Telephone Company, to restrain the company from carrying out certain underground works without having first obtained the consent of the Council, as required by the Telegraph Acts, was pending in the High Court. The solicitor to the Council had been in communication with the general manager of the company with reference to the matter, and had received the following letter from Mr. W. E. L. Gaine:—

the town.

to May, 1928 the company to equip all lines for overhead traction

I have now had an opportunity of consulting my board. Having regard to the fact that inter-communications between the competing systems of the Post Office and the company in London must in the nature of the case, be a matter of arrangement between the Postmaster-General and the company, and that the action of the Postmaster-General against the company was adjourned for three months with a view to giving time for negotiation, my board does not see its way to make any communication at the present moment to your committee; but I am to suggest that, as the Postmaster-General's action was adjourned upon terms which preclude the company from breaking up streets in the meantime, the action of the County Council should remain *in statu quo* for a like period.

The committee stated they had directed the solicitor to ascertain and report to them at what stage the negotiations between the Postmaster-General and the company had arrived, and they proposed to again report to the Council on the subject on receiving further information. Whilst on this question the committee mentioned that the Marylebone Vestry had decided to grant an application of the company for permission to lay conduits or pipes in various streets subject to the terms of an agreement for the protection of the Vestry's interests. The committee had informed the Vestry that the Council does not adopt the view taken by the company that, if it can arrange terms with the road authorities as to underground works, the consent of the Council is not necessary; and had pointed out that the action of the Vestry and certain other London road authorities, in entering into arrangements with the company, had a tendency to weaken the Council's position in its negotiations to secure favourable terms for telephone subscribers, as regards intercommunication between the company's system and that about to be established by the Post Office.

Manchester Telephones.—On the subject of telephone municipalisation at Manchester, the *Municipal Journal* says:—

The telephone question in Manchester has reached the acute stage by the resignation of Ald. J. W. Southern, chairman of the Telephone Committee of the Corporation. The City Council, it will be remembered, has formally approved the application of a competing company for a license within the Manchester area, that company undertaking, whenever called upon, to transfer its exchange to the municipality on equitable terms. It has been decided by the Committee to purchase (if possible on reasonable terms) the Manchester exchange of the National Telephone Company, and this company has been asked whether it is willing to sell, and upon what terms, it being the purpose of those who recommend this course to also recommend that any injustice done to the Mutual Company shall be recompensed by a pecuniary consideration. It appears to Alderman Southern that the National Telephone Company can prolong the present state of things for almost any period they choose. He regards this position as intolerably unfair alike to those citizens who are wishful for a more efficient and cheaper telephone service, and to those who, encouraged by the attitude towards them of the Corporation, have incurred serious responsibilities in their efforts to supply a competing system affording those qualities of efficiency and cheapness which are desirable. Such a position is both "inconsistent and uncomfortable" to Alderman Southern, who holds strongly to the opinion that the Government should own all intertown telephones, and that there should be free communication between all systems that are licensed by the Postmaster-General. Mr. Southern is chairman of the Committee which was appointed a short time ago, under the auspices of the Municipal Corporations Association, to report upon the practicability of municipal telephones and to collect all the information, technical and legal, which Corporation committees may require to deal with the matter. Mr. A. R. Bennett was requested to write a full report, showing the cost, under varying conditions, of working and maintaining telephones. Mr. Bennett's report, it is stated, shows that at a price of about 5 guineas a most efficient telephone exchange can be supplied.

The following memorial has been circulated among the members of the City Council:—

The memorial of the undersigned merchants, manufacturers, professional men, and other ratepayers showeth: That the delay in establishing competition in the telephone service in this city and district is a serious injury to us. That, in our opinion, it is incumbent on the City Council to comply with a company's request for confirmation of the resolution which encouraged the company to recognise and spend a large sum of money for the purpose of establishing competition. We think that the Mutual Telephone Company should be allowed to commence work and extend its system to other towns in close business relationship with Manchester, especially as they have repeatedly stated that they would transfer to the Corporation their Manchester service on fair terms if so desired subsequently. We respectfully request that the Council will permit no further delay, but confirm the resolution passed by it on April 14th, 1897, in favour of the Mutual Telephone Company at the next meeting of the City Council.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
WEST INDIES:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871)	Working badly. May 11, 1900.	
Mole St. Nicholas-Cape Haitien...	March 6, 1900 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Cayenne-Paramaribo ...	Feb. 16, 1900 ...	...
Ceará-Maranham	Feb. 20, 1900 ...	...
Pará-Maranham	March 1, 1900 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Manila-Iloilo	Apl. 9, 1900 ...	May 29, 1900.
St. Thomé-Loanda	May 20, 1900 ...	...
Tarifa-Tangier	Jan. 2, 1900 ...	...
LANDLINES.		
SOUTH AFRICAN:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communication beyond Newcastle	Nov. 7, 1899 ...	...
Communication with all offices beyond Kimberley and Germiston	Oct. 18, 1899 ...	...
Communication with all offices of Colombia beyond Buenaventura...	Feb. 22, 1900 ...	...
Communication "*vid* Hanekine" interrupted on Persian Territory	Feb. 24, 1900 ...	...
Ecuador landlines	Mch. 13, 1897 ...	...
Brazilian landlines, south of Macahe	Apl. 25, 1900 ...	...

The New German-American Cable.—A daily paper says that the new German-American cable from Emden to the Azores and New York will be ready for public use in August.

The Pacific Cable.—After some general comments upon the real importance of the proposed Pacific cable, considered strategically, the *St. James's Gazette* says:—"If the conferences at the Colonial Office do not shortly lead to some pronouncement as to the immediate fate of the cable, we may expect a general uprising of sentiment, both here and in the Colonies concerned."

Wireless Telegraphy.—The *Daily Chronicle* Berlin correspondent says that the German lightship on the Borkum Reef has been provided with apparatus for receiving and transmitting messages by means of the Marconi system of wireless telegraphy. Messages will be exchanged with ships at sea and with the land telegraph station on the island of Borkum, in the mouth of the River Ems. A charge of 10d. will be made for each message so transmitted, in addition to the ordinary telegraphic fees.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bermondsey.—June 18th. The Vestry is inviting tenders for insulated electric mains, conduits, junction boxes, &c. See "Official Notices" to-day.

Bootle.—June 16th. The Corporation wants tenders for underground electric cables, the erection of arc lamps, and the supply of mechanical stokers, for electric lighting. See "Official Notices" May 25th.

Blackpool.—June 18th. The Corporation wants tenders for the electrical equipment of 15 single truck tramcars. See "Official Notices" to-day.

Bradford.—June 14th. The Corporation wants tenders for a switchboard for 500 volts pressure, or for alterations to the existing switchboard at the Valley Road electricity works. See "Official Notices" May 25th.

Bridgwater.—June 7th. The Council wants tenders for the supply of boiler house plant, engine house plant, dynamos, pumps, switchboard, mains, lamp-posts, accumulators, meters, crane, &c., for electricity supply. See "Official Notices" May 11th.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Crewe.—June 11th. Tenders are wanted by the Corporation for the wiring of the municipal offices, market hall, and corn exchange, and for supplying lamps and fittings for electrically lighting (separate quotations for arc and incandescent lighting) the same. Tenders to Town Clerk.

Dudley. — June 15th. The Corporation is inviting tenders for a free wiring contract. See "Official Notices" to-day.

Durban.—June 29th. The Corporation wants tenders for overhead equipment for (*a*) about 16 miles of single track, including poles, overhead trolley wire, distribution boxes; (*b*) 22 double-deck motor cars; (*c*) steam and electric generating plant, including three 250-KW. generators, boilers, condensers, cooling towers, switchboard, &c. See "Official Notices" May 18th.

Ealing.—June 11th. The District Council wants tenders for storage batteries and a steam dynamo alternator for the electricity works. See "Official Notices" May 25th.

Egypt.—July 1st. Tenders are being invited until July 1st by the harbour and lighthouse authorities at Alexandria for the supply and erection of the necessary plant and apparatus required for the electric lighting of the harbour of Port Said. Tenders are to be sent to L'Administration des Ports et Phares, Alexandria, whence particulars may be obtained.

Germany.—June 7th. Tenders are being invited until June 7th by the Hamburg Finance Deputation for the supply of an electric launch. Tenders, marked No. 207, to be sent to Die Finanz Deputation, Hamburg. Particulars may be obtained from the Secretariat II. der Finanz Deputation, Rochhaus (Over-Erdgenhoss Zemmir 429).

Glasgow.—June 12th. The Corporation wants tenders for the supply of two sets of switchboards and instruments for 4,000 amperes each, for the electricity department. See "Official Notices" May 11th.

Grimsby.—June 1st. The Corporation wants tenders for arc lamp-posts and brackets. See "Official Notices" May 18th. Another notice invites tenders for a number of electric meters.

Halifax.—The Corporation wants tenders for bar copper for electrical purposes, as well as for boilers and piping. See "Official Notices" this week.

Italy. — July 14th. The Municipal authorities of Maddalena (Sardegna), are inviting projects and tenders until July

engineer to the Glasgow *tramways*). His estimate of the cost of an

company with reference to the matter, and had received the following letter from Mr. W. E. L. Gaine:—

14th, for the electric lighting of the public streets of the town. Particulars may be obtained from, and schemes and tenders are to be sent to, Il Municipio di Maddalena (Sardegna.)

Lincoln.—June 5th. The Electricity Works Committee wants tenders for the supply of about 1,400 tons of hard steam cobbles during the 12 months ending May 31st, 1901.

London.—June 1st. The City Corporation Streets Committee invite proposals for the hire of an electrically-driven dust cart. See "Official Notices" April 20th.

London.—June 4th. The Fulham Vestry wants tenders for the wiring of the electric lighting works. Conditions, specifications, &c., at the offices of Mr. F. H. Medhurst, on payment of a deposit of £3 3s., returnable as usual.

London County Council.—June 16th. The Council invites tenders for an electric lighting and power installation (excluding generating plant) telephones, fire alarms, &c., at the Horton Asylum, near Epsom. See "Official Notices" May 18th.

Manchester.—June 9th. The Tramways Committee wants tenders for the overhead equipment of three routes of tramways. See "Official Notices" May 25th.

Nelson.—June 12th. The Corporation invites tenders for a storage battery and switchboard. See "Official Notices" this week.

Newington.—June 15th. The Electric Lighting Committee requires tenders for supplying and laying conduits, mains, &c. See "Official Notices" this week.

Newcastle-on-Tyne.—June 1st. The New Tramways Committee wants tenders for switchboards, underground feeders, and pumping apparatus. See "Official Notices" May 11th.

Partick.—June 8th. The Commissioners want tenders for a dust destructor with furnaces, flues, water-tube boilers, economiser, fans, and forced draught appliances. See "Official Notices" May 18th.

South London.—June 2nd. The South London Electric Supply Corporation wants tenders for the complete installation of 3,000 lights on the premises of 500 consumers in any part of the area of the company's supply, and for the installation of two arc lights on the premises of any consumer in the same area. See "Official Notices" May 18th.

Spain.—July 7th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Ambassador at Madrid, stating that tenders are invited by the Spanish Government, to be received not later than July 7th next, for the concession for an electric tramway from the Puerta de Hierro (Madrid) to Aravaco and Pozuelo. Some particulars may be examined on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

St. Pancras.—June 7th. The Vestry wants tenders for rearranging and additions to bare copper strip conductors. See "Official Notices" May 25th.

Stockport.—June 13th. The Gas and Electricity Committee of the Town Council wants tenders for two water-tube boilers. See "Official Notices" this week.

Sleaford.—June 12th. Tenders for multitubular boilers, two steam dynamos and booster, pumps, waterheater, pipework, accumulators, arc lamps, posts and connections, switchboard, cables, and grounding are wanted by the Urban District Council. See "Official Notices" May 25th.

Sutton Coldfield.—June 21st. The Corporation invites tenders for water-tube boilers and other steam plant, pipework, three steam dynamos and boosters; batteries, switchboard, overhead traveller, mains and conduits, arc lamps and posts, and station lighting. See "Official Notices" May 18th.

Tanat Valley.—June 5th. The directors of the Cambrian Railways Company are prepared to receive tenders for the construction of a light railway, about 15 miles long, 4 feet 8½ inches gauge, commencing by a junction with the branch of the Cambrian railways at Port-y-waen, in the county of Salop, and terminating at Llangynog, in the county of Montgomery. Plans, specification, and quantities obtained, on payment of £1 1s., at the office of Mr. A. J. Collin, engineer to the Tanat Valley Light Railway Company, Oswald Road, Oswestry.

CLOSED.

Heywood.—On Monday, at a meeting of the Electric Lighting Committee, tenders for the new electricity works were considered. That for the chimney, 120 feet high, was given to Mr. C. Dennes, of Bury, and that for the electric light station, comprising engine house, boiler house, battery room, offices, and store rooms, to Mr. Daniel Diggle, Heywood. The letting of the tender for machinery and plant was deferred.

London.—The London County Council on Tuesday considered the following tenders for the wiring and fittings required in the electric lighting of the new fire station in course of erection in Upper Street, Islington:—

Barlow Bros. & Co. (accepted)	£277 0 0
F. A. Glover & Co.	296 3 0
F. J. Coleby	335 0 0
Private Wire and Telephone Installation Company	428 0 0
A. H. Wood	450 0 0

The undernoted tenders were also considered for wiring the Whitechapel fire station:—

F. A. Glover & Co. (accepted)	£282 6 0
F. J. Coleby	331 15 0
A. H. Wood	430 0 0
Private Wire and Telephone Installation Company	445 0 0

Rhyl.—The following is a list of the tenders submitted to the Council in response to specifications drawn up by Messrs. G. R. Peers and W. H. Trentham:—

SECTION A.

**Babcock & Wilcox*	*£2,013 10*	George Hill & Co.	£2,350 0
Blackwell & Co.	2,058 0	Stirling Boiler Co.	2,490 0
Crompton	2,058 0		

SECTION C.

**Clayton Engine Co.*	*£590 0*	Crompton	£902 0
Lowdon	599 0	John Fowler	920 0
Brook, Hirst & Co.	745 0	Dorman & Smith	930 0
General Electric	765 10	Hodgson, Wright	991 0
Lewis, Baylis & Co.	782 0	Mechan & Sons	999 0
Veritys	851 0	Electric Construction	1,085 0
Ashton, Frost & Co.	896 0	Siemens	1,242 0
Johnson & Phillips	900 0		

* Accepted subject to the sanction of the Local Government Board to the loan

SECTION B.—ENGINES, DYNAMOS, BOOSTERS, &C.

NAME OF TENDERER.	TYPE OF ENGINE.	AMOUNT.
Parsons & Co.*	Parsons	£5,017
Thames Iron Works	Allen	5,133
"	Reavell	5,268
Lancashire Dynamo Co.	"	5,359
Crompton & Co.	Allen	5,519
Lancashire Dynamo Company	Browett-Lindley	5,551
Westinghouse Company	Allen	5,560
General Electric	Reavell	5,572
Electrical Company		5,641
Lowdon	Reavell	5,682
**Lancashire Dynamo Company*	*Alley*	*5,759*
British Schuckert	Reavell	5,762
Allen	Allen	5,771
Lowdon	Browett-Lindley	5,809
Electric Construction	Reavell	5,882
Johnson & Phillips	Willans	5,870
British Schuckert	Browett	5,992
Westinghouse	"	5,995
John Fowler	Reavell	6,042
Thames Ironworks	Willans	6,112
Heywood	Alley	6,156
Lancashire Dynamo Company	Willans	6,204
Geo. Hill & Co.	Browett-Lindley	6,210
Crompton	Davey, Paxman	6,385
Siemens	Browett-Lindley	6,444
Lowdon	Belliss compound	6,569
Westinghouse	Willans compound	6,620
"	Belliss "	6,650
Lowdon	Willans "	6,677
General Electric	" "	6,702
Scott & Mountain	Scott & Mountain	6,750
Electric Construction	Willans compound	6,763
Clayton Engine Company	Alley	6,784
Crompton	Belliss	6,806
"	Willans	6,849
Electric Construction	Willans	6,852
Lowdon	Belliss triple	6,869
Crompton	"	6,903
General Electric	"	6,925
Westinghouse	"	7,040
Siemens	"	7,204
Frank Suter	Willans triple	7,205
Thames Ironworks	" "	7,239
Siemens	" compound	7,239
"	Belliss "	7,264
Lancashire Dynamo	Alley triple	7,453
" "	Willans triple	7,470
Lowdon	" "	7,677
Westinghouse	" "	7,680
British Schuckert	" "	7,702
General Electric	" "	7,768
Heywood	Alley triple	7,811
Crompton	Willans triple	7,880
Electric Construction	" "	7,931
Scott Anderson	" "	7,935
Johnson & Phillips	" "	6,090
Siemens	" "	8,249
Brush		8,314
Ashton Frost	" "	8,325

* Accepted subject to the sanction of the Local Government Board to the loan.

SECTION D.—ARC LAMPS, UNDERGROUND MAINS, STREET WORK, &C.

**Western Electric*	£5,911 11	Callender	£6,797 0
St. Helens Cable Co.	6,125 0	Siemens	7,013 0
Dennis	6,184 0	Glover	7,455 0
Oliver	6,229 0	Henley	7,464 0
British Ins. Wire Co.	6,545 0	Johnson & Phillips	8,181 0
Oliver	6,758 0	Telegraph Man. Co.	9,233 0

* Accepted subject to the sanction of the Local Government Board to the loan.

SECTION F.—ACCUMULATORS.

** Dutilh Smith (Marquand)*	£1,304	D.P. Battery Company	£1,446
Hart Battery Company	1,361	Chloride	1,500
Tudor	1,395	Heywood	1,577
Electrical Power Storage Co.	1,425	Scott Anderson	1,900
Johnson & Phillips (Hart)	1,430		

SECTION G.—CRANE.

** Marshall, Fleming & Jack*	£145	Stocks & Co.	£167
James Carrick & Sons	152	Messrs. Isles, Limited	220
Carrick & Ritchie	159		

* Accepted subject to the sanction of the Local Government Board to the loan.

Southampton.—The Council has accepted the tender of Messrs. S. Z. de Ferranti for an engine and generator at £3,600, subject to the electrical engineer being satisfied as to the design of the Schuckert dynamo.

Macabe ... ... Apl. 25, 1900 ... ...

Maddalena (Sardegna), are inviting projects and tenders until July

FORTHCOMING EVENTS.

Friday, June 1st.—At 9 p.m. Royal Institution of Great Britain. Discourse by Sir Henry Roscoe, F.R.S. Subject: "Bunsen."

Thursday, June 7th.—The Röntgen Society. Ordinary General Meeting at St. Bartholomew's Hospital, Electrical Department (by invitation of Dr. H. Lewis Jones). Dr. Lewis Jones will show an Influence Machine of American design. Mr. James Wimshurst, F.R.S., will give a short statement of his work in the Design and the Perfecting of the several forms of his Influence Machine. Dr. Rémy, of Paris, will show a new Localising Apparatus. The Annual General Meeting will be held in July.

Friday, June 8th.—At 5 p.m. Physical Society. Agenda: (1) "On the Magnetic Properties of Iron and Aluminium Alloys," Part II., by Dr. S. W. Richardson; (2) "Note on Crystallisation produced in Solid Metal by Pressure," by Mr. W. Campbell; (3) "On the Viscosity of Mixtures of Liquids and of Solutions," by Dr. C. H. Lees.

NOTES.

A Suggestion for the Prevention of Collisions at Sea.—No one will deny that a practical and efficient means of preventing collisions at sea would be welcomed by humanity at large, but, so far, nothing that can really be termed practical has been brought forward. We have recently been favoured with a copy of a pamphlet by Mr. Léonce Fabre, of Marseilles, which describes a system proposed by M. Orrechioni. It consists, in effect, of a species of torpedo furnished with two horn-like projections which is propelled electrically at the same speed as that at which the vessel travels, thus keeping the cables by which it is attached to the vessel taut, and tending to ensure the position of the "pilot" directly in advance of the ship's course. The "pilot" is to operate at a distance of about a quarter of a mile in front of the ship, and the horn-like projections when touched will indicate the fact on board the protected vessel. The projections are so connected electrically with an indicator on board the vessel to be protected that upon the starboard projection being touched the indicator will immediately display "port," and *vice versâ*. We fear that many instances will at once suggest themselves to our readers where this system of indication (apart from the effect of strong currents, porpoises, or similar "contingencies," upon the direction of motion of the "pilot") would break down. What would happen in the event of a ship crossing the protected one's bows in such a way that both projections would be touched simultaneously, is not dealt with in the pamphlet. Presumably, the indicator would show both "port" and "starboard," in which case the man at the wheel would be in the unenviable position described in that historic narrative the "Hunting of the Snark," where it is recorded that the Bellman, who was in command—

> . . . . was thoughtful and grave, but the orders he gave
> Were enough to bewilder a crew,
> When he cried—steer to starboard but keep her head larboard,
> What on earth was the helmsman to do?

The Visit of Electrical Engineers to Paris.—Mr. W. G. McMillan, the secretary of the Institution of Electrical Engineers, is sending out application forms and full particulars in connection with the forthcoming visit to Paris. An extraordinary general meeting of the Institution will be held there on Thursday, August 16th, two days before the opening of the International Electrical Congress. This meeting (on the 16th) will be a joint meeting of the Institution and the American Institute of Electrical Engineers, and the details will be given later. It is, however, necessary to know at the earliest convenient moment how many members propose to take part in the proceedings, so that Messrs. Cook & Son may be able to make the necessary arrangements. A fee of 40 francs is payable to the French committee by those who wish to take part in the Electrical Congress.

Good Firing and Smoke Prevention.—The Committee of the Western Railway Club in Chicago have recently presented a report on the "Smokeless Consumption of Fuel as Applied to Locomotives," but some of their conclusions have equal application to the firing of stationary boilers. In their opinion, apparently, there is nothing so effective in smoke prevention as skilful firing, and the general opinion seems to be that a good fireman can accomplish more without special devices of any kind than an indifferent fireman with them. It is necessary for the engineer and fireman to understand each other; the fireman should be informed in advance of every change that the engineer has to make, so that the fire may be kept in readiness for the changes. There is a good field for the expert or travelling firemen in the education of the man. The practice of firing five or six skipfuls at a time and resting between should give place to light and frequent firing, the door being left open on the latch to admit air enough to burn the fresh distillates, and then closed, unless a damper is provided in the door. There is no panacea for smoke. The necessary treatment varies with the quality and position of the coal. The matter is largely in the hands of the fireman and engineer, and firing should be done in such a way as to avoid chilling the surface of the fire by excessive increments of coal, the method of adding fuel being to scatter it in thin layers and admit sufficient air to consume the hydrocarbons which are distilled off in large volume as soon as the fresh coal drops upon the hot fire.

The Municipal Electrical Convention at Huddersfield.—The official programme of the Municipal Electrical Association's convention to be held at Huddersfield on June 20th, 21st, 22nd and 23rd has been issued. The Council cordially invites all who may be in any way interested in the meetings to attend. The president for the year is Mr. A. B. Mountain, and he will deliver his address on Wednesday, June 20th, at 10 a.m., at the Technical College, Queen Street South. The following papers will then be read and discussed:—

"Means for Stimulating the Demand for Electrical Energy." Two Papers by Alderman W. Potter, Taunton; H. C. Bishop, electrical engineer, Wigan.

"Electricity Works for Small Towns." Two Papers by C. S. Vesey Brown, electrical engineer, Lincoln; G. M. Harris, electrical engineer, Bray.

Thursday, June 21st.

"Electric Motors." Two Papers by T. P. Wilmshurst, Derby C. A. L. Prussman, Doncaster.

"Combined Management of Tramways and Lighting Departments." By R. C. Qain, Blackpool.

"Methods of Reducing Light Load Losses." By H. L. P. Boot, Tunbridge Wells.

The Association Dinner at the Town Hall, at 7.30 p.m.

Friday, June 22nd.

(At the Albert Hall, Cookridge Street, Leeds.)

"The Distribution of Electricity in Scattered Areas." Two Papers by L. Andrews, Hastings; G. Wilkinson, Harrogate.

"Maintaining Certain Portions of Electrical Distribution Systems at Earth Potential." By C. H. Wordingham, Manchester.

"Impressions of Present American Tramway Practice." By A. E. Le Rossignol, tramway engineer, Newcastle-upon-Tyne.

"Protection of Telegraph and Telephone Wires." By R. C. Qain, Blackpool.

There will be visits to various works of interest, electric lighting, tramway, and so on, at Bradford, Huddersfield, Leeds, &c.

Obituary.—We regret to hear of the death of Mr. Wm. Johnson, who was, until February last, manager of the electrical department of the Sheffield Corporation. It will be remembered that when the works of the Sheffield Electric Light and Power Company were taken over by the municipality in January, 1898, Mr. Johnson, who had been manager from the starting of the undertaking, entered the service of the Corporation. At one time he figured among telephone inventors, and seems to have been largely responsible for the establishment of a telephone exchange in Sheffield. Mr. Johnson was 56 years of age. He had been in ill health for some time past, and his more serious illness is stated to have dated from the death of his wife in January last.

(*Continued on page* 931.)

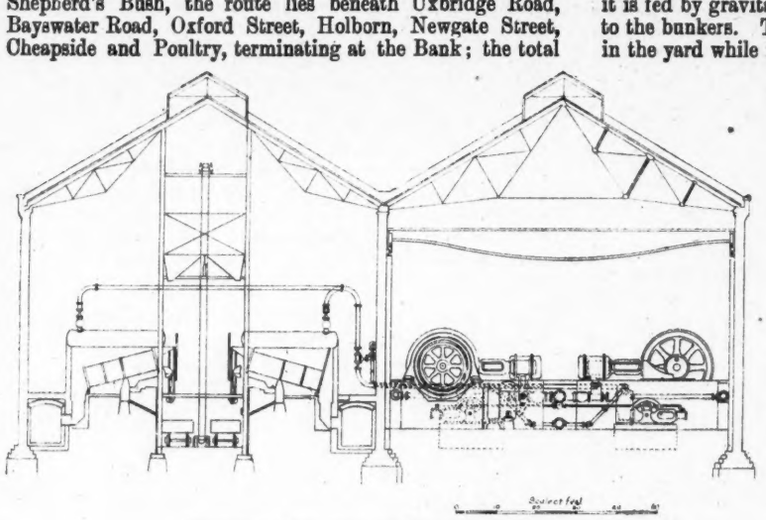
Private Wire and Telephone Installation Company	..	428 0 0	
A. H. Wood	..	450 0 0	

Schuckert dynamo.

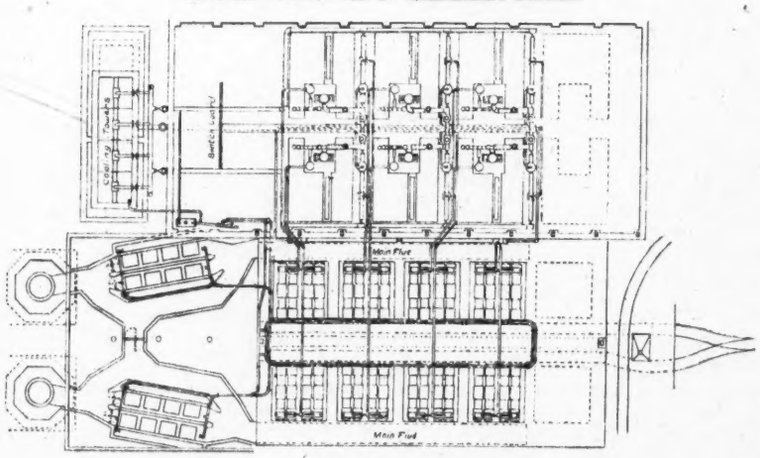
CENTRAL LONDON RAILWAY.

HOWEVER backward the metropolis may be in the matter of surface traction, there can be no doubt that as regards underground electric railways London leads the world. The first step was taken, under the guidance of the late Doctor John Hopkinson, by the City and South London Railway Company, which, by the way, originally intended to use cable haulage, and provided for this in the designs. This railway remained unique for nearly eight years, before the Waterloo and City Company's line was opened for traffic in 1898.

The line with which we are now concerned will, it is hoped, be opened for traffic during the coming summer, and must be regarded as by far the most important undertaking of this description in existence or projected. Starting from Shepherd's Bush, the route lies beneath Uxbridge Road, Bayswater Road, Oxford Street, Holborn, Newgate Street, Cheapside and Poultry, terminating at the Bank; the total length is 5¾ miles between termini, in two tunnels, and the capital expenditure will amount to nearly three millions sterling.



SECTIONAL ELEVATION OF GENERATING STATION.



PLAN OF GENERATING STATION.

The trains, each of which will consist of seven carriages hauled by a separate locomotive, will run at intervals of 2½ minutes, at an average speed (including stoppages) of 14 miles per hour; each train seats 336 passengers, and weighs 105 tons, loaded, without the locomotive.

The average stay at each station will be 20 seconds, and the maximum speed between stations will be about 25 miles per hour. To maintain the 2½-minute service 22 trains will be required; but as the frequency will be increased later on to a 2-minute service, requiring 28 trains running, 28 locomotives have already been provided.

The tunnels are for the most part 11 feet 6 inches in diameter, constructed on the system invented by the late J. H. Greathead, and lined with cast-iron. There are 13 stations, communicating with the platforms 100 feet below by means of electric elevators; the distance between stations varies from 1,288 yards to 642 yards, averaging about 850 yards.

The generating station is situated at Shepherd's Bush, on what used to be known as Woodhouse Park; the site extends over an area of about 20 acres, affording ample space for the station, car and locomotive sheds, workshops and sidings for all present and future needs. The general arrangement of the buildings is shown by the accompanying plan.

The boiler house is constructed of red brick, with iron and slate roof, and measures 148 feet × 87 feet inside; the boilers are arranged in two lines, one on either side of a central gangway, over which are situated the coal bunkers at a height of 25 feet from the floor.

The coal supply is brought in wagons over a siding from the West London Extension Railway, and is dropped into a hopper outside the south end of the boiler house; from this it is fed by gravitation to the coal conveyor and carried up to the bunkers. The coal is weighed on a weighing-machine in the yard while it is in the trucks.

The conveyor is of Messrs. C. W. Hunt Company's make, exactly similar to the one which we recently described in connection with the Ringsend power station; it comprises 200 buckets, in which the coal is carried along the basement beneath the stoking floor, up the north wall of the building, and along beneath the roof to the bunker which it is desired to fill. The mechanical filler, by means of which each bucket is automatically filled full without scattering coal, is shown in one of our views, as well as the gear for tightening the conveyor chain; the latter consists of a semi-circular section of railway which can be drawn outwards by means of tension screws fixed to the end wall. The line of conveyor is also shown to advantage in our view of the top of the bunkers, with the automatic motor "pusher" at the far end; views of the latter were reproduced on page 661 of the ELECTRICAL REVIEW. The bunker, which has a capacity of 1,000 tons in the 16 hoppers at present in use, and measures 140 feet long × 28 feet wide, is built of sheet-iron, and is divided into separate compartments, one for each boiler; a trip lever is provided opposite each compartment, and the coal is deflected to one or other side of the middle partition as desired by means of tilting shoots, of which several are seen in our view.

The conveyor makes one complete cycle in 10 minutes, at which rate 60 tons of coal can be carried into the bunkers per hour, each bucket carrying about 1 cwt. The motor driving the conveyor is of the British Thomson-Houston Co.'s C.E. type, 8-H P. size.

The ash handling arrangements consist of a full-gauge railway from the surface level into the tunnel beneath the boilers, dividing there so as to permit wagons to run close to the boiler foundations; the ashes are raked from the ash-pits direct into the wagons, and removed by means of a steam locomotive. Eventually, however, it is intended to remove the ashes by means of the conveyor.

The boilers are of the Babcock & Wilcox type, 16 in number, arranged in eight batteries of two boilers each, and disposed equally on either side of a central gangway.

Each boiler has 3,580 square feet of heating surface, with a grate area of about 90 square feet, and evaporates 12,000 lbs. of water per hour at 160 lbs. per square inch; each consists of 16 sections of 10 tubes, 4 inches diameter and 18 feet long, expanded into headers, two steam drums 3 feet 6 inches diameter × 23 feet 7 inches long, and a mud drum 10 inches diameter × 9 feet 8 inches long. The two steam drums are connected by a cross drum 2 feet diameter × 7 feet 6 inches long, and the cross

mittee by those who wish to take part in the Electrical Congress.

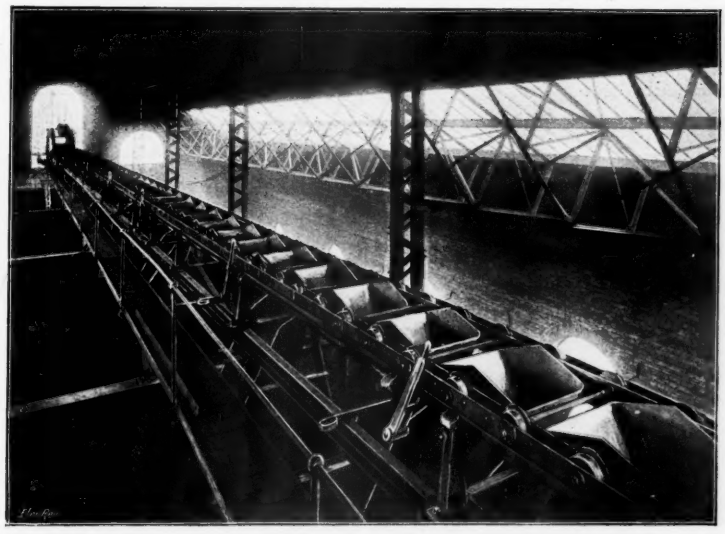
(*Continued on page* 931.)

drums of each battery of two boilers are joined by a steam pipe, from the upper side of which starts the 8-inch steam pipe to join the main steam pipe.

We give a view of the top of the boilers, showing this arrangement.

The sections are tested during construction with a hydraulic pressure of 300 lbs. per square inch, and after erection a test pressure of 240 lbs. per square inch is applied to the whole boiler.

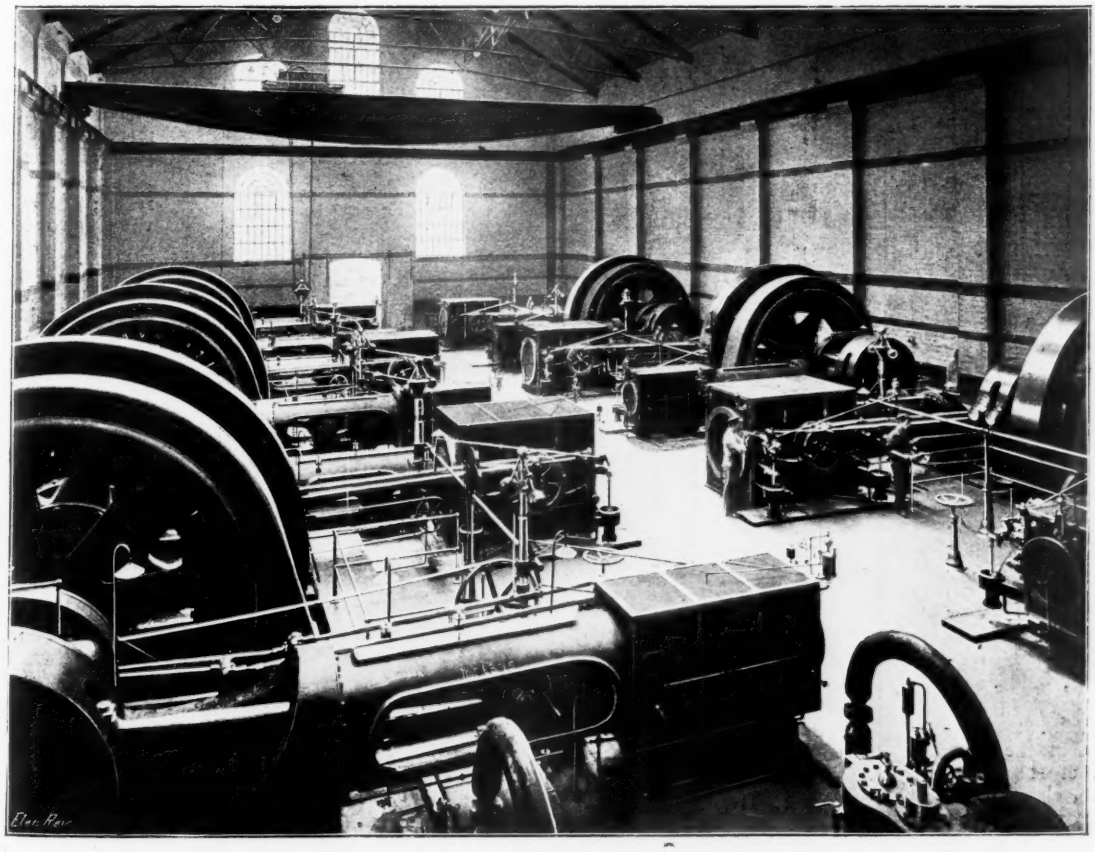
The mechanical stokers are of the Vicars type, driven by either or both of two Bumstead and Chandler engines by means of shafting run below; coal is fed to the hoppers of the stokers through chutes, a sufficient amount being allowed to flow into the chute by means of a valve operated by a chain. A platform runs along the front of the boilers to give access to the fittings, &c.



COAL BUNKERS AND CONVEYER.

right angles to their length, and provided with suitable valves to cut off any desired portion. There is room in the boiler house to accommodate four additional boilers, for which the foundations are already in position.

Water is derived from the Grand Junction Waterworks Company's mains by means of two pipes, one from Caxton Road, the other from Wood Lane. The degree of hardness of the water is 15 to 16, which is reduced to 3 or 3½ degrees by means of a large Archbutt - Deeley water softener, installed by Messrs. Mather & Platt. In this process, to 24,000 gallons of water there is added 28½ lbs. of lime and 9 lbs. of soda; after mixing for 10 minutes, air is blown through the water by means of perforated pipes lying on the bottom of the tank. Finally, 8 lbs. of alumina ferric are mixed with the water,



GENERAL VIEW OF ENGINE ROOM, FROM SWITCHBOARD GALLERY.

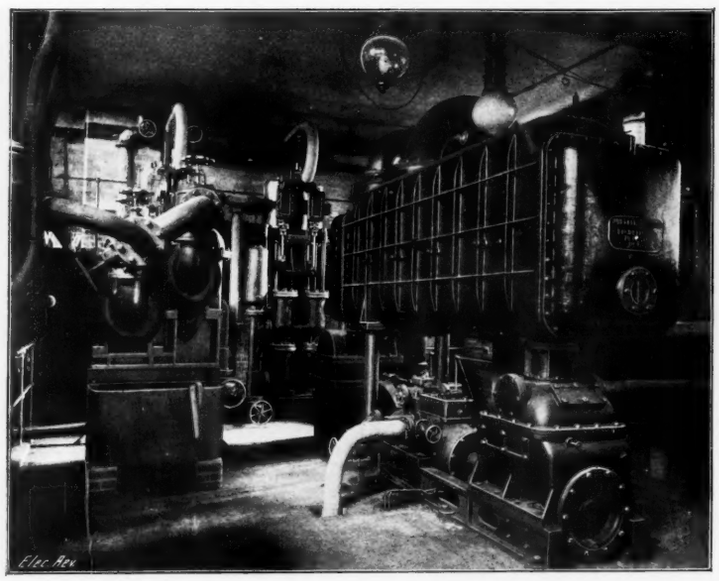
The steam piping is so arranged that each battery of two boilers practically feeds one engine; all the pipes are, however, put "in parallel" by a main steam pipe running at

and as it is drawn off it is carbonated by blowing coke gas into it.

After passing the softener, the water is either delivered

stations, communicating with the platforms 100 feet below by means of electric elevators; the distance between stations long. The two steam drums are connected by a cross drum 2 feet diameter × 7 feet 6 inches long, and the cross

to the cistern beneath the cooling towers or passes direct to the suction mains of the boiler feed pumps, the latter consisting of two vertical duplex direct-acting feed pumps, made by Messrs. F. Pearn & Co., which are visible in the background of our view of the auxiliary condensing plant. The diameter of the pump rams is 8 inches, and of the steam cylinders 12 inches, with a stroke of 15 inches; each pump is capable of delivering 16,000 gallons per hour at boiler pressure, a rate sufficient to keep the whole of the boilers supplied.



AUXILIARY CONDENSING PLANT, FILTERS, AND FEED PUMPS.

The greater portion of the feed water, however, is drawn from the delivery pipes which run from the jet condensers to the cooling tower, so as to obtain it at the greatest possible temperature before entering the feed pumps, which then either pass it through the economisers to the boilers, or in case these are out of service, it can be delivered direct by a separate main; in any case it is passed through a set of Railton & Campbell feed water filters. The whole of the condensed steam from the auxiliary plant passes through a Wheeler surface condenser of 1,900 square feet of cooling surface, having the circulating and air pumps placed horizontally beneath the same. The circulating water is taken from the cistern beneath the cooling towers and returned to the same after being cooled. The air pump discharge, however, is passed direct to the cistern. Our view shows the filters and surface condenser, which, with the feed pumps, are situated in the basement at the north end of the engine room, close to the cooling tower.

WATER-TUBE BOILERS, WITH MECHANICAL STOKERS.

The economisers, four in number, are of the "Green" type situated in two separate chambers to the north of the boiler house; each consists of 768 tubes of the usual dimensions, in four groups of 192. Suitable gates are provided in the main flues, so that the waste gases may be led through either or both sets of each pair of economisers, or direct to either or both of the chimney stacks, while the feed water may also be supplied through either or both sets of economisers to either or both lines of boilers, or may be fed direct to the latter, as desired.

The scrapers of each pair of economisers are driven by a small direct current motor of 5 H.P. output.

The two chimney shafts are of brick, 250 feet in height, and 10 feet in diameter at the base, with 10 feet clear diameter inside at the top, and are lined half-way up with fire-brick.

The engine room adjoins the boiler house, and measures 200 feet × 86 feet; it is lined with yellow enamelled brick, and is lighted from the roof as well as from the walls. It is spanned by an overhead traveller capable of lifting 30 tons, worked by hand, and manufactured by Messrs. Booth Bros., of Rodley.

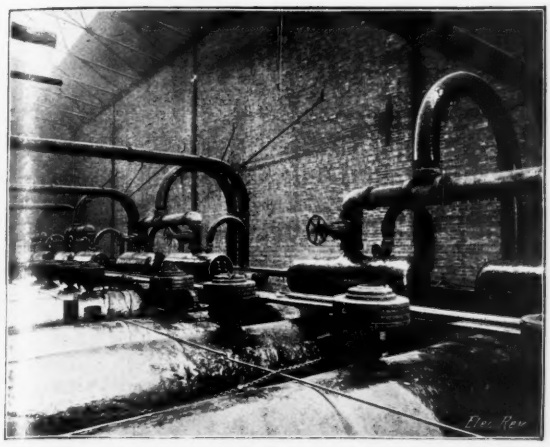
The floor is occupied by six cross compound Corliss engines driving three-phase generators, together with exciter and lighting sets, while the switchboard is mounted on a raised gallery across the north end of the room; one of our views shows the general arrangement of the plant, which presents an exceedingly fine appearance.

The main engines were made by the E. P. Allis Company, of Milwaukee, and are of the horizontal condensing type, each rated at 1,300 I.H.P. at the most economical load, and capable of working continuously at 1,950 I.H.P. when necessary. The arrangement of the fly-wheel and alternator between the cranks is well seen in our view of a single set. The cylinders are 24 and 46 inches in diameter, with a stroke of 48 inches; neither cylinder is jacketted, but the exhaust chambers are cast separately from the cylinders to minimise condensation. The valve gear is of the Reynolds-Corliss type, with automatic variable cut-off, actuated by two eccentrics on each cylinder; the low pressure gear can, however, be disconnected from the governor, and is

boilers practically feeds one engine; all the pipes are, however, put "in parallel" by a main steam pipe running at

After passing the softener, the water is either delivered

adjustable by hand while the engine is running. The clearance is not over 3 per cent. in the high pressure, and 2 per cent. in the low pressure cylinder. The maximum range of cut-off is up to $\frac{3}{4}$ stroke in both cylinders.



Arrangement of Steam Pipes.

A weighted fly-ball governor controls the valve gear of both cylinders, with a speed variation less than $1\frac{3}{4}$ per cent. between light and full load. The engines normally run at 94 revolutions per minute; but should the speed from any cause rise to 105 revolutions per minute, steam is instantly cut off by an emergency governor acting directly on a stop valve.

Before entering the high pressure cylinder the steam passes through an Allis separator placed between the engine foundations; after passing through the cylinder the steam enters a receiver, where it is dried by means of a multitubular re-heater supplied with boiler steam. The piping is so arranged that either cylinder can be operated independently, if necessary, taking a load of 900 I.H.P.

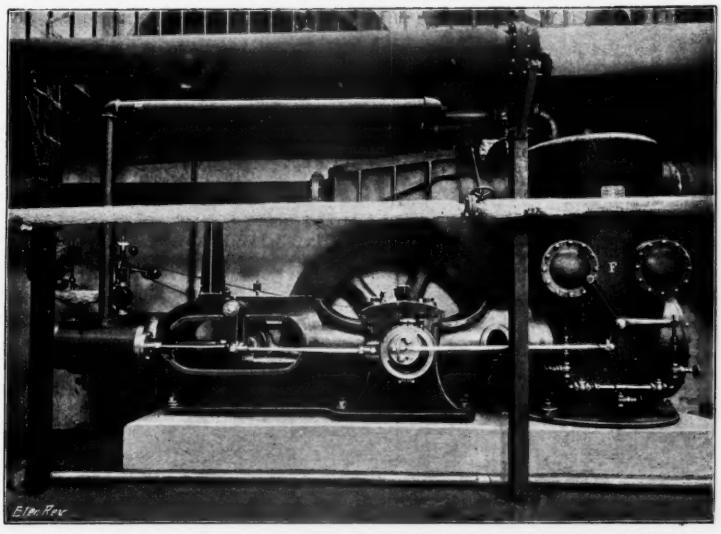
The fly-wheel is 18 feet in diameter, weighing 100,000 lbs., and is made in eight segments, held together by wrought-iron arrow-head straps in the rim, the arms being bolted to the hub. The rim is so designed that it may be run at 110 revolutions per minute without receiving support from the arms, and the whole will be safe at 125 revolutions per minute.

The crankshaft is of hammered scrap-iron, 22 inches diameter in the fly-wheel and armature, and 20 inches at the journals, which are 36 inches long. Each bearing is made in four parts, lined with Babbitt metal expanded in place.

The crank pins are 8 inches diameter, forced into the disc cranks and riveted over; the connecting rods are 12 feet long between centres, of forged steel. The frames are extra heavy, with bored slides, and are cast with oil catchers to collect all oil thrown off by the moving parts.

The main exhaust pipe runs down the centre of the building between the foundations, and is carried up outside the north wall to a height of 10 feet above the roof; it is of wrought-iron, 24 inches diameter, with copper bends at the engines; the arrangement of the exhaust pipes and condensers is such that each engine may be run condensing or exhausting to atmosphere, with an automatic valve to guard against failure of the vacuum in the former case. There are six jet condensers, fixed in the basement between the foundations, and combined with the air pumps; they are of the E. P. Allis Co.'s make, and are shown in one of our views. Each condenser is capable of dealing with 26,000 lbs. of steam per hour normally, or 30,000 lbs. if required. The pump is double-acting, 28 inches diameter, with a stroke of 24 inches, and can lift the condensing water from a depth of 20 feet, and deliver it to the top of the cooling towers while maintaining a vacuum of $26\frac{1}{2}$ inches of mercury. The pump is driven by a single 12-inch steam cylinder, the exhaust from which is led into the receiver of the main engine, so as to secure the economy of compounding. The tappet valve seen on the condenser in our view, is intended to admit a small quantity of air, in order to prevent mechanical shocks by providing a slight amount of cushioning—not sufficient, however, to impair the vacuum to any appreciable extent.

(To be continued.)

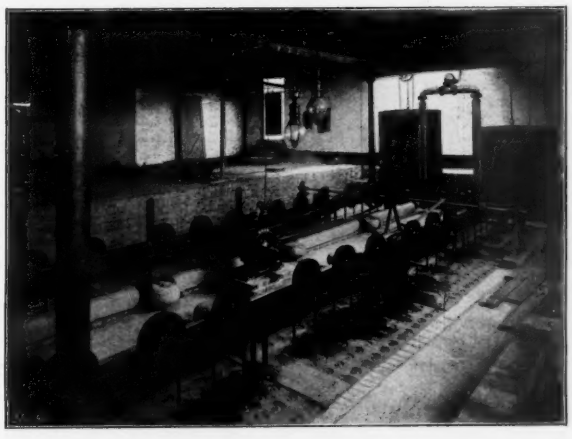


Jet Condenser and Air Pump.

THE ECONOMICAL DEVELOPMENT OF MANUFACTORIES.

[COMMUNICATED]

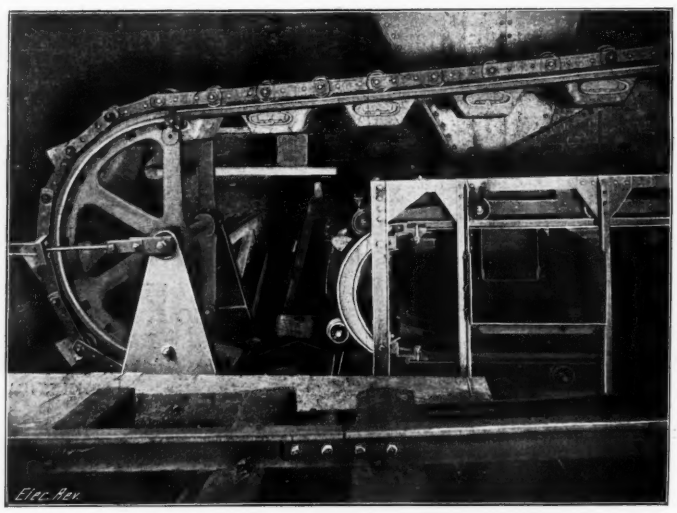
It may be held that the question of introducing economies into workshops has been thrashed out, but occasionally contributions are made regarding the directions in which developments could arise, which must be noted with a certain degree of fulness. It is practically beyond dispute that we are much behind America and Germany, not only in using labour-saving tools and appliances, but also in specialising and utilising to the fullest extent the undoubted advantages of technical education; and it is a matter of considerable interest at the moment that, though the greater portion of the



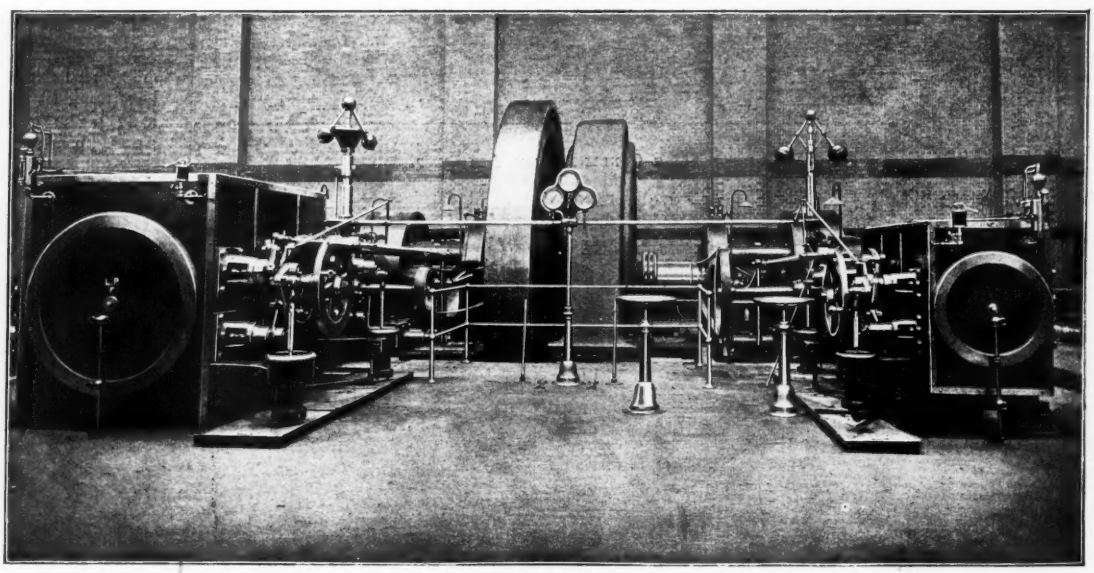
One of the Economiser Sets.

male adult population of Germany is compelled to undergo some form of military training, yet in many respects Germany is probably our most formidable rival in the world's market.

Some pertinent remarks have been recently made by Mr. W. Arnold in a paper read before the Birmingham Association of Engineers, and although he is compelled to use many time-worn arguments, there are certain points which he brings forward that are of considerable interest. Taking for his theme the ideas of the engineer regarding the economical development of manufactories, Mr. Arnold maintains that the engineer will play a prominent part in the development of manufacturing concerns. It is a somewhat remarkable fact that engineers in many cases are successful according to the manner in which they handle the commercial questions that arise in manufactories. We have prominent before us the instance of the electric lighting industry, where the most conspicuous success has been attained by those men who have grasped the commercial possibilities of their systems, and left most of the technical questions to take care of themselves. This is as it should be, for, after all, there is not very much that is technically new in the electric light works that are being put down to-day; or the matter may be summed up better by saying that technical questions are not now so important as the commercial ones. There is little doubt that the future prosperity of many undertakings will largely depend upon the number of automatic machines employed; this specially applies to engineering works, and though the old-fashioned methods that are said to prevail in these shops are very deeply rooted, it must not be forgotten that really serious attempts are being made by many firms to bring themselves into line with modern ideas. There are, however, many industries that need almost a revolutionary process before they can be said to be conducting their works on economical lines. A very conspicuous instance of this occurs in the paper-making industry, where the machines are usually driven by separate engines of very ancient type, and are amazingly uneconomical in their working. In such a case it might be held that the electric motor was somewhat unfitted to replace steam engines, because the work is practically continuous, but there are instances on record where the electric motor has been adopted for driving paper-making machinery with the greatest success, the advantage arising in the steadier working of the machines. In other words, there have been fewer stoppages, with the result that the output has been materially increased. In adopting automatic machinery and labour-saving tools in shops, there is obviously a limit; and, as Mr. Arnold points out, there are many trades whose productions are rarely, if ever, alike, covering a wide range of various articles, and, in such a case, it would be very difficult to introduce special machines for producing large quantities of work. Even in such cases, however, there is no reason why special arrangements could not be made to manipulate and handle the products in an economical manner. Analysing the whole question of introducing engineering specialities and mechanical appliances, the subject is summarised in "how much money can we save between the coal shovel and the machinery? or otherwise, in the cost of making steam, and the cost of using it?" In electrical works we are accustomed to the use of special machinery for handling fuel, and we quite agree with the author that "there are many industries where the cost of handling the coal and ashes has been ignored." The results that have been achieved in our own industry in the use of fuel economisers, and of forced and induced draft, suggest that there may be many cases where steam is used in which their introduction would be



Mechanical Filler and Tension Gear.



Steam Alternator.

justified. Almost the same remarks could be applied to superheating, and though the question may have been somewhat overdone, we do not doubt that important results have been achieved by superheaters. There is little doubt that the most economical engine can generally be accepted as the best; but it by no means always follows, and in this matter, automatic expansion plays a very important part. On the subject of gas engines, Mr. Arnold considers that they compare favourably with steam engines up to about 60 H.P., and at lower powers, possess greater advantages, especially where steam is not required for heating, drying, or steam hammer work; but, says the author, "for higher powers steam can be employed with greater economy." This is probably more or less true at the present moment, but it would be rash to prophesy that the future will not bring some greatly needed improvements in the internal combustion engine, which will render it a formidable competitor of the steam engine even up to 1,500 H.P. On the general subject of electricity Mr. Arnold points out that "it is a mistake to class electrical machinery under the head of generating plant; it is in every sense of the word a link between the steam plant and the machinery that has to be driven."

The point is whether it is an economical agent, and that can only be decided by the circumstances surrounding any particular case. We feel, however, that though much has been done to demonstrate the economical distribution of power that can be effected by electrical means, there are a multitude of cases where electricity could be applied with the greatest advantage. It is true that in some special instances electricity has given remarkable results, and it is probable that a mechanical form of transmitting power might have had considerable success if up-to-date methods had been adopted; but we can hardly agree with Mr. Arnold when he cites a particular case of electricity supplanting steam engines, by raising the question "Whether a still greater efficiency in working could not have been obtained if the whole plant had been rearranged and reorganised and driven by economical steam engines, with power transmitted by shafting, ropes, and belts, and still the initial cost of this system would certainly not be greater." We have seen some exceedingly good examples of the economical transmission of mechanical power, but the weakness of Mr. Arnold's arguments is, nevertheless, obvious, because he says, "If the whole plant can be rearranged." That is one of the instances where electricity shows to great advantage. Moreover, we may take it that when separate steam engines have been employed in driving machinery, it has been because the area has been scattered, and the machinery has been used more or less intermittently. Under such circumstances we affirm that electricity has no rival. Besides, it must not be forgotten that the use of shafting and gearing brings in other expenses, some portion of which ought to be placed to the cost of a mechanical system of transmission. In using shafting and its tributary gearing, stouter walls are required, and it is remarkable how largely this bulks in the design and erection of a factory. It may interest the author of the paper to learn that one factory, which was designed specially for electrical transmission, actually showed a saving of £3,000 in the buildings over what would have been necessary if shafting and gearing had been employed. Mr. Arnold lays considerable stress upon the advantages of rope-driving, and there is no doubt that in certain districts where special industries abound, some noteworthy results have been achieved. Though there may be some instances of rope-driving showing better results than electrical, there are cases where electricity has supplanted a rope system with the most beneficial results. In summing up the various modes of transmitting power, "electricity has," says Mr. Arnold, "the preference, where power is required in various small intermittent quantities, and covering a great area of ground; or where it is required in isolated buildings, such as explosive or inflammable mill manufactories; but in compact and well-arranged works the power absorbed in driving shafting and rope, or belting and gearing, does not exceed 20 per cent. of the effective horse-power of the engine, and, in an up-to-date plant, it should not exceed half that amount, and can be run with much greater economy and efficiency." If such conditions could be realised in actual practice, we fear that the opening for electricity would not be very great, but to suggest that any mechanical form of transmission of the power to the machine would not lose more than 10 per cent. is a counsel of perfection that is hardly likely to be realised in any manufactory. It is quite true, as Mr. Arnold states, "that the arrangement of a plant with a view to economy in production is in many works in this country strikingly absent." There is an absence of cohesion between the various departments that is most apparent to a stranger. It would seem obvious in designing any system of manufacture that there should be a steady progress of the raw material through the various stages without any turning back. In other words, the raw productions should go in at one end of the factory, and the finished article from the other end, and the various stages should be those of steady progression. In this respect, American methods are much better than ours, and although there is a certain amount of excuse to urge on behalf of old-fashioned works, we think that under some circumstances it would be worth while to recast the whole method of production, in order to arrive at an economical system. The author states that "it is now generally conceded by the up-to-date engineer, that the modern factory should be equipped with a plant of a maximum productive capacity, and that every square foot of space must be regarded as an augmentive factor in the expense account. That the best management and organisation of workmen and plant is that which produces the greatest output per square foot of floor space and per hour of time, and that the maximum effects in these directions cannot be secured with low-priced men or equipments." We cannot help quoting the concluding remarks of Mr. Arnold, with which we are almost in entire agreement:—

"There is really no lack of technical ability in this country, but the difficulty lies in being able to apply it in a practical manner. Our American and German competitors do not lay claim to the invention of many of the most successful machines, but they have carefully applied all the best processes and inventions of ours to their own use in a scientific and practical manner; and, at the same time, we are at perfect liberty to adopt any of their methods if they are superior to our own. In America, where material is dearer than in this country, where labour is more expensive, and the cost of transit greater, they, however, supply us with machinery, tools, and appliances in large quantities and at a less price than we can produce them ourselves. Several industries they have practically taken from us, notwithstanding the fact that both labour and material are more expensive there than here; this is because they have gone into the manufacture more systematically and scientifically. It should, however, be borne in mind that although the Americans are supplying steam engines to this country, some of the most powerful ones used in the United States are of English manufacture, and also that in many of the best establishments in America we should find, if not an Englishman, at least a Scotchman, in control.

"If we pursue the same course as our competitors, by systemising on economical lines, and adopting the most advanced methods of production, the cries we are so fond of raising against ourselves, of want of technical knowledge and ability, want of energy and enterprise, the decay of our industries, and the fall of our commercial supremacy, would be cries of the past; and the race for supremacy in the manufacturing world would be a race run on merits."

NOTES.

(*Concluded from page* 925.)

Electric Launches on the Thames.—The suggestion which we put forward in our leader on "Progress in Electric Traction" a few weeks ago—viz., that a rapid and efficient service of electric passenger launches should be placed on the Thames instead of the now defunct steamboats—has quickly borne fruit. The *Daily Mail*, commenting in advance on the discussion which was expected to take place at the London County Council on Tuesday last, strongly advocated the

adoption of electricity for the motive power, and the idea has been favourably received in other quarters also. There can, we think, be no question as to the relative economy of this system as compared with that formerly in use, while the gain in convenience, speed and comfort is in itself more than sufficient to justify the innovation. Judging, however, from past experience of the County Council and its ways, we cannot help doubting whether that omniscient body will have the courage to embark on such an obviously advantageous and progressive enterprise. We hope we shall find our forebodings mistaken.

The Light that does not Fail.—It is seriously announced in the columns of a contemporary, the name of which we consider it charitable to suppress, that a company with a capital of $25,000,000 has been formed to develop an invention which should not be without some influence upon the present methods of obtaining artificial light. An American chemist is stated to have sold to the above mentioned company the patent rights in an invention by means of which a light is produced in a glass bulb previously exhausted by certain chemical reactions. The light is stated to be the equivalent of imprisoned sunlight. Once imprisoned the light does not go out. It can be carried about "in the pocket with one's purse or case of cigars, from which it can be drawn when it is desired to see clearly."

Marine Engineers' Certificates.—A deputation of marine engineers and members of Parliament representing various seaport towns waited on Mr. C. T. Ritchie, M.P., President of the Board of Trade, at Whitehall Gardens, a few days ago for the purpose of discussing the subject of certificates of marine engineers. Sir J. F. Flannery, M.P., said the deputation represented the views of very nearly the whole of the engineering trade of the country, and the matter in question was the improvement of the efficiency of marine engineers. The suggestion which the deputation had to make was that there should be a modification of the Board of Trade Regulations made under the existing Acts of Parliament with regard to marine engineers' certificates. Mr. Ritchie, in reply, said it was essential that the engineers employed on board ship should be fully qualified to perform the very responsible duties which devolved upon them, and, therefore, if it could be shown that the existing condition of things and the existing regulations did not secure that supply of efficient engineers which was necessary, then a good case was undoubtedly made out for some alteration. The present regulations had been in force a great many years, and he did not know that it had been shown by experience that they had led to the employment of engineers who had not been sufficiently qualified to perform the work cast upon them. It would be better for all concerned that they should move somewhat tentatively in the matter, and his suggestion was that the Board of Trade regulations ought to be amended so as to secure four years' workshop experience instead of the three years now necessary.

The Price of Energy Increased at Edinburgh.—From an "Electric Lighting Note" in another column it will be observed that it has been found necessary, at Edinburgh, to increase the charge of energy from $3\frac{1}{4}$d. to $3\frac{3}{4}$d. per unit on account of the higher price of coal and the large expenditure on the new undertaking.

Appointment.—Mr. E. Taylor, assistant engineer at the tramway electric power station, Sheffield, has been appointed chief assistant engineer for the Birkenhead Corporation tramway system, to supervise the installation of an electric tramway service.

Appointments Vacant.—The Southport Corporation want a depôt superintendent and an inspector in connection with the electric tramway system. See "Official Notices" to-day.

The Council of the Municipal Electrical Association want a gentleman having an office in London to act as secretary under the direction of the honorary secretary. See "Official Notices" this week.

Two lecturers are required for the electrical and engineering departments of the City of Birmingham Municipal Technical School at £160 and £125 respectively. See "Official Notices" to-day.

A tramway engineer is wanted by the Brighton Corporation to control the carrying out of the construction of the electric tramway system. Applications to be lodged with the Town Clerk, Town Hall, by June 8th.

A senior demonstrator is required for the department of electrical engineering and applied physics at Finsbury Technical College. Salary, £150 to £200. See "Official Notices" to-day.

The District Council of Buxton wants an assistant electrical engineer; salary, £100 per annum.

The Electric Lighting Committee of the Hull Corporation wants an assistant electrical engineer; salary, £150 per annum.

The Electric Committee of Belfast Corporation wants a charge engineer.

The Blackburn Corporation wants a shift engineer; salary, £2 a week. See "Official Notices" this week.

Personal.—Dr. J. Erskine Murray has left the employment of Marconi's Wireless Telegraph Company, Limited, as the appointment which he held has been done away with.

Correction.—We regret that in our description of Messrs. Rickard's cable works, we unfortunately misspelt Mr. R. Dunsford's name as Dunscombe.

IMPERIAL TELEGRAPHIC COMMUNICATION.

Sir Edward Sassoon has done yeoman's service in awakening the attention of the public to the very unsatisfactory condition of our means of communication with the outlying parts of our Empire. Complaints and protests have not been wanting, but hitherto these have had little or no effect, owing to the lack of organisation amongst those affected. It has been left to Sir Edward to lay before the Government and the public, in a clear and concise form, the history of these grievances, which might otherwise have been forgotten almost as soon as published. We believe that Sir Edward is supported by a large and representative House of Commons Committee, whose chairman and spokesman he is, and we are also aware that he represents the views of the Associated Chambers of Commerce of Great Britain and India on this subject. Under these conditions we would ask the attention of our readers while we lay before them a statement of the case as now presented. We have frequently dealt with this subject before, but the time seems ripe to return to a further consideration of the position.

Last week, in the House of Commons, Sir Edward Sassoon rose to call attention to the cable telegraphs of the Empire, and to move—"That it is desirable that an inquiry should be held into the commercial and strategic defects of

Imperial telegraphic communication." In support of this, many instances were given of the inefficiency of the present system of cables. It was pointed out that at the time of the Jameson raid the cables to the Cape were not up to their work; and that despite this warning the companies owning the African cables had done nothing to ensure a trustworthy service, so that at the most critical part of the war in which we are now engaged, we had to run the same risk of being cut off from news of our troops as was formerly the case. It seems that the cables along the East Coast of Africa, laid as a consequence of the Zulu war 20 years ago, had been left unduplicated, with the exception of the Mozambique-Zanzibar line, and this although the company concerned had not only received over £1,368,000 in subventions from various Governments, but had also earned a very large revenue besides. Although this wretched state of affairs has, fortunately for us, been remedied within the last few months by the laying of a new cable northwards from the Cape *viâ* St. Helena and Ascension; still, we must not necessarily write that down to the credit of the companies interested, as it may well have been laid for their self-protection in view of the impending laying of a cable by their competitors with the object of sharing in the large gains from South African messages. In reference to Indian telegraphs it was pointed out that while the Indian Government delegate at the last International Telegraph Conference did his best to procure a reduction of tariff, he was signally defeated in his efforts by the Eastern Telegraph Company, and yet in spite of the attempt made by the representative of India, the Indian Government line which runs from Karachi to Fao and Bushire in the Persian Gulf, and thence by landline to Teheran, still remains the greatest stumbling block in the way of reduction of rates. Figures were also forthcoming to show the gross injustice of this attitude; it was shown that the Indian Telegraph Department earned considerable dividends, and this after paying over money into the joint-purse in which, for some abstruse reason, the Indian Government had become a partner with the Eastern group of companies. Sir Edward pointed to the unfairness and bad policy of maintaining the charge to India at 4s. per word, while that to South Australia, double the distance, was equally 4s. per word, and this, despite the fact that the Eastern Telegraph Company were content to receive 1s. 2½d. as their share on messages from England, passing through Bombay, destined for Australia. Various other striking anomalies were pointed out, and the speaker suggested that the rate to India should be reduced to 1s. per word. That this change might not entail any considerable loss to the companies concerned during the time which might elapse before this lower rate should prove profitable, Sir Edward Sassoon suggested that the Indian Government, conjointly with the Treasury, should bear one-third of such temporary loss until the natural expansion and elasticity of traffic should allow of the money so advanced being refunded to the Governments. A rather inexplicable relationship between Her Majesty's Government and the companies was brought to light, viz., that, although according to the International Telegraph Convention 2d. per word on all extra-European messages to and from England should be levied by the Treasury, that is not done; and so the companies are the gainers of a very considerable sum which, if not required by the Treasury, should at least not be taken from the telegraphing public. The reason given by the Government is that by the Telegraph Act of 1869 they are not entitled to claim this "terminal tax"; but as Sir Edward argues, does not the subsequent convention agreed to by the Government cancel the somewhat rash clause in the Act of 1869?

In supporting the motion, Sir C. Dilke dealt almost entirely with the strategic side of the cable question, and after referring to the ease with which shallow water cables could be cut in time of war, and the danger of the present cable landing places in the shallow water off the Cornish coast, pointed out the comparative safety of those cables landed in the deep water on the West Coast of Ireland. Sir C. Dilke also concurred with Sir Edward Sassoon in recommending the State-ownership of cables, and supported the demand for a thorough and independent inquiry into the whole subject.

Mr. Sydney Buxton expressed himself in favour of a clear and settled Government policy in regard to cables, so that the present conflict between the interest of the State generally, and the existing cable companies, might be placed on a satisfactory footing. He showed that such reductions as had been made by the companies, had almost invariably been made under danger of competition, and quoted as an instance, the case of the Cape-Australia cable, where large subsidies had been asked, but immediately competition appeared to be likely, the companies not only withdrew their demand for subsidies, but also proceeded to lower their rates. The vigorous opposition offered by the companies to the scheme of the Pacific and other all-British cables, was denounced by Mr. Griffith Boscawen as detrimental to the growth of the Empire. While a Russian officer at Vladivostock pays 4d. per word to telegraph to St. Petersburg, an English officer in India is constrained to pay 4s. per word to telegraph to London. In closing his address the speaker said that "he earnestly hoped that the Government would persist in the scheme of an all-British Pacific cable, and that they would agree to a full and fair inquiry into this great question, so that our whole cable system might be put on a sounder and more Imperial basis."

In replying to the various speakers, Mr. Hanbury sought to draw a distinction between commercial and strategic cables, and on these grounds to point out an inconsistency in the resolution; but as the motion was simply for "an inquiry into the defects of the present system of Imperial telegraph communication," the inconsistency does not exist. The Secretary for the Treasury dealt with the whole subject in a very optimistic tone—"Everything is for the best in the best of all possible worlds." He expressed satisfaction with the existing system, which, although it had grown up in a haphazard way, was such as to "excite the jealousy of foreign countries." That it might excite their jealousy and still not satisfy our requirements did not seem to occur to the speaker, who, indeed, went on to say, possibly as grounds for further satisfaction, that the cables were interrupted on one side of Africa on an average for 60 days in the year, and on the other side for 40 days in the year. In speaking of India, however, it was admitted that the case was an absolutely exceptional one, as "he thought that there the company had tried to create an artificial monopoly which was not in the public interest." It appears that in some way, not explained, the companies had been able to bind the Indian Government down to an agreement which the latter had found reason to regret, and which has, probably, been the cause of the difficulty in getting the rate lowered. In concluding, Mr. Hanbury hoped that the resolution for a public inquiry would not be pressed, but that the inquiry should rather be left to a departmental committee; as for strategic reasons, publicity was not desirable. It was only after an appeal from Mr. Balfour that the motion was reluctantly withdrawn.

Now this termination to the debate strikes us as eminently unsatisfactory. It was clearly shown, and could not be denied, that the present condition of affairs calls for inquiry and amendment from the commercial aspect alone, and yet we have the whole question shelved. We have but little faith in this departmental inquiry. Who are those who are going to deal with the question? Surely not the same individuals and departments who have given us but little cause to place confidence in them, as shown in the case of the Pacific cable. In the Post Office are those who have shown themselves so unacquainted with deep-sea cables as to recommend a core of 940 lbs. of copper and 940 lbs. of gutta-percha, to judge in this matter? In the India Office are those who have allowed themselves, as Mr. Hanbury shows, to be outwitted in an agreement with the companies, to be called into consultation? In the Colonies are officials who, after having studied the question "more than anyone else" report a (non-existent) depth of 12,000 fathoms in the Pacific, to be accepted as authorities? To put it shortly, are the Departments which have hitherto failed to satisfy public requirements to be accepted as sufficient judges in their own case? Tweedledum sitting in judgment on Tweedledee! The thing is quite absurd. It is clear that a full and public inquiry is necessary; for as regards the strategic side of the question, all that foreign nations require to know they have already found out.

At a meeting of the Society of Arts, where Sir Edward Sassoon read a paper on "Imperial Telegraphs" last Monday, Sir H. Fowler, who was in the chair, expressed himself

strongly and eloquently in favour of an extension of our cable system, as well as for such a reduction in cost of telegrams, even at some expense to the State, as would help to bind the Empire closer together. Sir Patrick Playfair, Sir John Leng, Mr. C. E. Pitman, and others, spoke in the same strain, and advocated a full and complete inquiry into the whole subject, as opposed to a departmental and perfunctory inquiry which partakes of the nature of "hole-and-cornerism."

NEW COMPANIES REGISTERED.

British Electric Trust Company, Limited (4,551).—This company was registered in Edinburgh on May 26th, with a capital of £100,000 in £10 shares, to carry on the business of electrical, mechanical, hydraulic and general engineers, machine makers, structural builders, general and engineering contractors, iron, steel and brass founders, forgers and coppersmiths. The first subscribers (each with one share) are:—J. G. Stewart, Bredisholm, Baillieston, Lanark, ironmaster; T. Lander, Oolzium House, Kilsyth, gentleman; W. Spence, Oatcleigh, Allos, civil engineer; W. Dick, 13, Exchange Place, Glasgow, merchant; W. Todd, 449, Sauchiehall Street, Glasgow, banker; J. Allan, 25, Bothwell Street, Glasgow, shipowner; and J. Mackenzie, 150, St. Vincent Street, Glasgow, writer. The number of directors is not to be less than three nor more than seven. The first are J. G. Stewart, T. Lander, W. Dick and W. Spence; qualification, 100 shares; remuneration not to exceed £1,500 per annum, divisible. Registered office, 154, St. Vincent Street, Glasgow.

Staines and Egham Light Railway Company, Limited (65,989).—This company was registered on May 19th, with a capital of £1,000 in £1 shares, to carry on the business of constructors and proprietors of light and other railways and tramways, electrical and general engineers, electricians, suppliers of electricity, &c. The first subscribers (each with one share) are:—W. Smee, Norfolk House, W.C., solicitor; J. C. Macgregor, 38, Elmbourne Road, Upper Tooting, S.W., barrister; E. B. Wallis, 20, Linden Grove, Sydenham, clerk; G. Eyles, 110, Mount Pleasant Lane, Upper Clapton, N E, gentleman; J. T. Clarke, 68, Mornington Road, Wanstead, clerk; R. Forster, 103, Bancroft Road, E., clerk; and J. H. Smee, Clun House, Surrey Street, W.C., gentleman. Registered without articles of association.

Electric Supply Company of Victoria, Limited (66,059).—This company was registered on May 26th, with a capital of £200,000 in £1 shares, to carry on in Victoria, Australia, or elsewhere, the business of electricians, suppliers of electricity for light, heat, traction, motive power and other purposes, electrical and general engineers, contractors, &c. The first subscribers (each with one share) are:—W. M. M. Forward, 15, Union Court, Liverpool, solicitor; A. E. Haptie, 5, Durham Road, Seaforth, near Liverpool, manager; C. O. Grindrod, 11, Knowsley Road, Rock Ferry, Cheshire, solicitor; J. W. Lintern, 22, Beaumont Street, Liverpool, book-keeper; T. M. Waters, White House, Fazakerly, near Liverpool, book-keeper; F. J. Leslie, 15, Union Court, Liverpool, solicitor; and H. J. Russell, 25, Demesne Street, Seacombe, Cheshire, book-keeper. The number of directors is not to be less than two nor more than seven. The subscribers are to appoint the first; qualification, £100; remuneration, £200 each per annum (£250 for the chairman), and a share in the profits.

Wear Electrical Engineering Company, Limited (66,055).—This company was registered on May 25th, with a capital of £5,000 in £1 shares, to carry on the business of electricians, electrical and mechanical engineers, makers of electrical apparatus and appliances, suppliers of electricity, founders, smiths, machinists, &c. The first subscribers (each with one share) are:—J. G. Kirtley, 9, St. Thomas Street, Sunderland, sanitary engineer; G. W. Bain, 46, John Street, Sunderland, insurance broker; T. Harrison, 9, Bridge Street, Sunderland, steel and tool merchant; W. Burns, 74, Hendon Road, Sunderland, grocer; F. J. Trewhitt, 158, Fawcett Street, Sunderland, solicitor; T. S. Roden, 118, Rye Hill, Newcastle-on-Tyne, agent; and A. White, 9, Tunstall Vale, Sunderland, electrical engineer. The number of directors is not to be less than three nor more than five; the first are John G. Kirtley, George W. Bain, Thomas Harrison, William Burns, and Francis J. Trewhitt; qualification, £100.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Brockie-Pell Arc Lamp, Limited (48,876).—This company's annual return was filed on May 3rd, when 79,965 shares were taken up out of a nominal capital of £80,000 in £1 shares. £1 per share has been called up on 25,620 shares, resulting in the receipt of 25,606 17s. 6d. £13 2s. 6d. remains in arrears. £54,380 is considered as paid on 54,380 shares. £21 17s. 6d. has been paid on 35 forfeited shares.

Folkestone Electricity Supply Company, Limited (51,825).—This company's annual return was filed on May 8th, when the entire capital of £50,000 in £5 shares had been taken up and paid in full.

Willans & Robinson, Limited (40,660).—This company's annual return was filed on May 2nd, when 40,000 preference and 40,000 ordinary shares were taken up out of a nominal capital of £500,000 in 50,000 preference and 50,000 ordinary shares of £5 each; £5 per share has been called up on 15,337 preference and 15,338 ordinary, and £3 per share on 10,000 preference and 10,000 ordinary shares, resulting in the receipt of £215,375; 144,625 is considered as paid on 14,463 preference and 14,462 ordinary shares.

National Electric Wiring Company, Limited (53,364).—This company annual return was filed on April 20th, when 118,971 shares were taken up out of a nominal capital of £250,000 in £1 shares. 12s. 6d. per share has been called up on 100,120 shares, resulting in the receipt of £62,448 12s. 6d., leaving £126 7s. 6d. in arrears. £750 has also been paid in advance of calls. £18,851 is considered as paid on 18,851 shares.

SUPPLY STATION ACCOUNTS.

Southport Corporation Electricity Accounts.

The accounts of the Southport Corporation electricity undertaking for 1897-98 are very favourable, and Mr. C. D. Taite, the engineer of the Corporation, is to be congratulated on the results attained. The capital is moderate for the output and maximum load, while the increase in both these quantities shows that the business is a progressive one.

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£63,056	£76,179	£13,123
Number of units sold	376,490	589,350	212,860
Maximum load in kilowatts ...	404	591	187
Gross revenue	£6,661	£9,383	£2,722
Gross profit	£3,498	£5,561	£2,063
Average price per unit sold ...	4·13d.	3·80d.	−·33d.

The receipts have increased by nearly £3,100 from the sale of current, but as the meter rents have been reduced, and returns from other sources have slightly fallen, the increase in total revenue is a little less than this. The price per unit has been lowered, with the result that the average has fallen from just over 4$\frac{1}{10}$d. to 3$\frac{4}{5}$d., or a drop of $\frac{1}{2}$d. This very moderate figure should encourage a still larger custom. One interesting feature is that while the total receipts per unit have come down by nearly $\frac{1}{2}$d., the total costs of production have fallen by almost exactly the same amount. The output is distributed as follows:—

	Units generated.	Private supply.	Public lighting.	Number of public arc lamps.
1897 ...	532,862	291,277	85,213	42
1898 ...	809,289	501,005	88,345	42

The sundry receipts in the revenue statement include £12 in each year for moiety of premiums. This is an item we consider should not be treated as Corporation revenue; such amounts should really go into the pocket of the engineer, who has all the worry and responsibility of training pupils.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase
Sale of current ..	£6,477	4·13d.	£9,342	3·80d.	−·33d.
Meter rents	130	·08d.	29	·01d.	−·07d.
Supply of lamps, &c.	12	·01d.	...	...	−·01d.
Sundry	42	·03d.	12	...	−·03d.
Gross revenue	£6,661	4·25d.	£9,383	3·81d.	−·44d.

The costs have been reduced on each item. In "coal," notwithstanding a rising market, a material reduction has been effected, and the figure brought down to ·32d. The improvement in works' costs is over $\frac{1}{3}$d., and on the other items making up total costs $\frac{1}{10}$d., or nearly $\frac{1}{2}$d. in all.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£626	·40d.	£781	·32d.	−·08d.
Oil, waste, water, and engine room stores	141	·09d.	222	·09d.	...
Salaries and wages incurred in generation and distribution	1,205	·77d.	1,339	·55d.	−·22d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	364	·23d.	429	·17d.	−·06d.
Works' costs	£2,336	1·49d.	£2,771	1·13d.	−·36d.
Rent, rates and taxes	187	·12d.	276	·11d.	−·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c,	360	·23d.	437	·18d.	−·05d.
General establishment charges, stationery and printing, law charges and insurance	280	·18d.	338	·14d.	−·04d.
Other expenses	...	...	...	...	...
Total costs	£3,163	2·02d.	£3,822	1·56d.	−·46d.

Of the £2,063 increase in gross profit, £679 is absorbed by the greater interest and repayment charges, leaving the net profit £1,384 more than in 1897. Part of this has been paid towards relief of the rates and the remainder is divided between depreciation or credit of capital account, and an account to cover a small sum disallowed by the Local Government Board.

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,416	£1,920
Sinking fund for repayments	1,438	1,613
Net profit carried forward	644	...
" " to rates	...	620
" " to credit of capital account, &c.	...	1,408*
Gross profit	£3,498	£5,561

* To credit of capital account, £1,204, and "disallowance by Local Government Board, £204."

Bradford Corporation Electricity Accounts.

THE increase in tramway load and the attention given to motors have a very marked effect in last year's accounts of the Bradford Corporation electricity undertaking. The increase in output has reached nearly one million units, but the maximum load in kilowatts has only increased at about half the rate which would correspond to the total output and load, indicating a very material improvement in the load factor.

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£170,225	£210,055	£39,830
Number of units sold	1,419,306	2,416,130	996,824
Maximum load in kilowatts ...	1,589 KW.	2,010 KW.	421 KW.
Gross revenue	£22,498	£30,455	£7,957
Gross profit	£12,785	£16,960	£4,175
Average price per unit sold ...	3·60d.	2·82d.	−·78d.

The revenue statement shows nearly £8,000 additional receipts over 1898. The increase in power supply at a low figure has caused the return per unit to drop by over $\frac{3}{4}$d., but owing to the large number of motors and arc lamps hired out, the revenue from this source is rising rapidly. At the same time the reduction in meter rents has produced a drop almost balancing the increase attributable to hire of other apparatus. Almost half of the increase in gross revenue is gross profit.

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of current ..	£21,299	3·60d.	£28,367	2·82d.	−·78d.
Meter rents ..	641	·11d.	889	·08d.	−·03d.
Supply of lamps, motors, &c.	547	·09d.	1,247	·13d.	+·04d.
Sundry	11	...	2	...	...
Gross revenue	£22,498	3·80d.	£30,455	3·03d.	−·77d.

The public lighting is still restricted within somewhat narrow limits, but is being extended. The output was distributed as follows:—

	Units generated.	Private supply.	Public lighting.	Tramways.	Number of public lamps.
1898 ..	1,568,459	1,124,996	32,291	202,019	20 arcs and 11 incandescent.
1899 ..	2,858,841	1,738,844	59,004	618,282	51 arcs and 12 incandescent.

The costs show the effect of the rise in price of fuel by the increase in this item from ·33d. to ·36d.; reductions are made in all the others; the result being to bring down the total costs to the very favourable figure of about 1$\frac{1}{3}$d., as against 1$\frac{3}{4}$d. in 1898. "Rent, rates, &c.," have actually fallen in the gross by nearly £200; a rather unusual feature. Mr. Chattock is to be congratulated on the figures, and it must be added that Mr. Gibbings's work in years gone by is bearing excellent fruit.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase
Coal	£1 932	·33d.	£3,579	·36d.	+·03d.
Oil, waste, water, and engine room stores.	462	·08d.	640	·06d.	−·02d.
Salaries and wages incurred in generation and distribution.	1,953	·33d.	2,553	·25d.	−·08d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	955	·16d.	1,465	·15d.	−·01d.
Works' costs	£5,302	·90d.	£8,237	·82d.	−·08d.
Rent, rates and taxes ..	1,142	·19d.	928	·09d.	−·10d.
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	1,025	·17d.	1,164	·12d.	−·05d.
General establishment charges, stationery and printing, law charges and insurance	1,281	·22d.	1,659	·16d.	−·06d.
*Other expenses..	963	·16d.	1,507	·15d.	−·01d.
Total costs ...	£9,713	1·64d.	£13,495	1·34d.	−·30d.

* Incandescent lamps and maintenance, &c., of arc lamps and motors on hire.

In the costs the item "Other expenses" covers the charges for maintenance and repairs of motors, &c., which is productive of the revenue in the earlier statement given as "Supply of lamps, motors, &c." In the "Profit statement" the amounts carried to depreciation fund are devoted to "Depreciation of capital."

PROFIT STATEMENT.

	1898.	1899.
Interest on loans and overdraft	£3,905	£5,083
Sinking fund for repayments	4,730	6,747
Net profit carried to depreciation fund ..	3,249	3,816
" " forward	901	1,314
Gross profit	£12,785	£16,960

CITY NOTES.

The Improved Electric Glow Lamp Company, Limited.

FORTUNE was not kind to the Improved Electric Glow Lamp Company in its earliest years, for in the six months ending December, 1897, there was a loss of £5,000, and for the same period in 1898 a reduced loss of £2,000. For the corresponding period of last year this loss was converted into a profit—a small one, it is true—only £39—but the fact that any profit has been earned would seem to denote that the corner has been turned. The directors are eager that the profits shall increase during the next few years in the same ratio as the loss has decreased between 1897 and 1899. To do this when weighted with the inflated original capital of £100,000 is recognised as an impossible task. Therefore the directors have thought the present an opportune moment to suggest the drastic measure of writing down the capital by 60 per cent. Reconstruction with a capital of £40,000 is the step proposed. The patents were unfortunately valued at quite a fancy figure, and "as some time has elapsed since the formation of the company," it is considered advisable to reduce the value of the foreign patents "by writing off £30,526 17s. 4d., thus

reducing this asset to £26,194 16s. 2d." A very necessary reduction, it is true, but we imagine shareholders have wanted to know why the original value was placed at what is now admitted to be an unwarrantably high figure. Furthermore, is the present reduction under this head an adequate one, considering the circumstances of the case? The £26,194, as we read the circular, will then represent the amount standing to the debit of the "British, Colonial, and foreign patents."

These strong measures are evidently being taken partly as a result of the patents having "been the subject of inquiry from time to time by the shareholders." But other reductions have to be made in the assets given in the last balance-sheet on account of lamp stocks now unsuitable for the English market "for various causes," a reduction of book debts (on first year's trading, chiefly). Even this is not the full extent of the reduction, for the shares held in other companies are swept from the balance-sheet with one stroke of the pen, as their value is uncertain (*sic*), and "it is not considered prudent to treat such items as assets." The amount lost in this way is not stated in the circular before us.

The basis of reconstruction which is recommended is the issue of one new share for every two now held, with a liability of 2s. 6d. on each new share. A small call of 1s. per share is "essential for the carrying on and development of the business," and is anticipated to be "all that is necessary until some tangible results can be shown." If this reconstruction scheme is carried through successfully—and we see no reason why it should not be—the chances of dividends being earned appear to be infinitely greater than they could ever have been with the original capital. The company seems to be in a fair way for doing good business, although it has to face keen competition, and it appears to us that shareholders should follow the proposed course, so as not only to save the concern but to turn it into a prosperous electrical undertaking. It is true that the company is a lamp company, but it does not propose to confine itself to lamps, for it is now developing its silvering branch, and is devising and supplying special fittings for street lighting in provincial towns. With the present period of all-round activity there ought to be a fair chance for an electrical company whose supplies have been well pushed in various directions during the past year or two.

A meeting of the company was held at Cannon Street Hotel yesterday, but as our representative was informed that the proceedings were private we are unable to say what transpired.

British Aluminium Company, Limited.

The fifth ordinary general meeting of the shareholders of this company was held on Thursday of last week at the Westminster Palace Hotel, under the presidency of Mr. W. R. Wallace, Q.C.

The Chairman, in moving the adoption of the report, said that the four factories of the company which had been built at Foyers, Larne, Greenock, and Milton had all been working satisfactorily. Last year there was a great drought all over Scotland, but by means of the water which they were able to obtain from their storage reservoirs they were able to keep all their works going. Although the company had been in existence nearly five years their engineering works were not completed until 1897, and then they had had to educate their workmen, so that they had not been in a position to earn any profits until the last 2½ years. They had also had to educate the public in the use and the advantages of aluminium. A few years ago aluminium was a curiosity; now it had become one of the most useful metals in the arts, but it was exceedingly difficult to get manufacturers to use a new metal. In this country people were somewhat conservative, and did not jump at novelties in the same way as they did in other countries, with the result that they had to wait before they could get the benefit of their outlay. Perhaps, however, that was a good thing in the end, because when once we in England did get hold of a thing, the industry was very much more solid and steadier, and in the end probably brought greater profit. To give them some idea of the work that their staff had to do, he might mention that in the 2½ years he had referred to they had had 14,000 different orders. Most of them had been for very small quantities of the metal as trial orders. As a result, the company had had a very large amount of work thrown upon it which could not be said to be remunerative, and so they did not earn profits; in fact, in some cases they had made a loss, but they were satisfied that they were laying the foundation for future business and future profits. Another drawback was in connection with the Government. They took a long time in referring to their experts, and so as yet they had not been able to derive any profits from Government orders. There were an immense variety of things used by the Army for which aluminium was suitable, and as Lord Roberts had issued an Army order dealing with the necessity for greater mobility and lighter equipment of the soldiers and transport, he had no doubt it would lead to a greater adoption of aluminium at an early date. To mention another difficulty, they could not persuade the railway companies that aluminium was not a precious metal; and accordingly in their freight charges it was classed as such. In undertaking a work of the kind they had largely to look to the future, and the shareholders, he believed, appreciated that fact. Still, if they took the whole five years of the company's existence, it would be seen that they had earned 35 per cent. on the capital, and in the last 2½ years, taking the reserve into account, they had been able to provide practically 20 per cent. in dividends, so that the preference shareholders would have received 4 per cent. interest on their investment. Seeing that they would also take a share of the future profits, he thought they would agree that that was not a very bad result, seeing that most of the work the company had done, was for the future, and not for the present. The only two competitors the company had on this side of the Atlantic, were their friends in France and Germany. The company in France had to wait a long time before they paid any dividend, but last year it paid 7 per cent., and also a profit was made on the founders' shares. The increase in the French business was largely due to the motor car industry, for in the manufacture of automobiles aluminium was largely used. In this country that industry was only in its infancy, and he was pleased to see that in the recent 1,000 miles' tour most of the machines used aluminium. The German company, which had a capital very similar to their own, had paid the very respectable dividend of 13 per cent., but they had the advantage of half their product being taken by the Government. They intended to issue fresh capital for the development of the business, especially in connection with the Highland Water-Power Company. They had been rather unfortunate in connection with the carbide of calcium industry. They ordered plant, which, unfortunately, had not been all delivered yet, so that they had had to keep a portion of their water-power idle, and they had not had the profit which they would have made from the manufacture of carbide. Their relations with the Acetylene Illuminating Company were exceeding friendly, and they were shareholders in that concern. The carbide industry was increasing tremendously, and if they had the means of supplying the wants of the consumers they would have derived a large profit; but they must look to the future.

Lord Kelvin seconded the resolution. He said he had been connected with the company from its commencement—first as scientific adviser and for the last two years as one of the directors. It was most interesting work, and the company had worked to secure the best possible results for the shareholders. Of course it would be more satisfactory if their progress had been more rapid, but it was satisfactory in this respect—that if it went on at the same rate a great future of practical success was assured. There was a great augmentation in the practical use of aluminium, and there was every reason to believe that the demand for the metal would go on increasing year by year. The question of water-power was of supreme importance, more especially in view of the great increase in the price of coal, and he believed that the water rights which they possessed, and which were now being augmented on a very satisfactory basis, would be an exceedingly valuable property to the company.

The report was then adopted.

An extraordinary general meeting was subsequently held, when, on the motion of the Chairman, seconded by Dr. Common, F.R.S., the following resolution was agreed to:—"That the capital of the company be increased to £400,000 by the creation of 10,000 new shares of £10 each, to be called 'A' cumulative preference shares, to which are attached the following special rights and privileges, that is to say:—(1) The said new shares shall carry a fixed cumulative preferential dividend at the rate of 6 per cent. per annum on the capital for the time being, paid up or credited as paid up thereon. (2) The said new preference shares shall rank for dividend in priority to the existing preference and ordinary shares of the company. (3) The said new preference shares shall in the event of the winding up of the company be entitled to rank as regards repayment of capital in priority to the existing preference and ordinary shares of the company, but the said new preference shares shall not be entitled to any further participation in surplus assets. (4) The said new preference shares shall be issued to such persons and on such terms and conditions as the board may think fit."

Callender's Cable and Construction Company, Limited.

The fourth annual general meeting of Callender's Cable and Construction Company, Limited, was held at the Cannon Street Hotel on Thursday last week, Mr. H. Drake presiding.

In moving the adoption of the report, the Chairman said he hoped that the shareholders would consider the balance-sheet satisfactory, because, having regard to the difficulties they had had in the past year, the directors were rather disposed to think that it was a very satisfactory account. The report alluded to the rise in price of practically all the materials they used in the factory. The chief rise had been in the case of copper, tin, and lead, of which they used a great deal, and it was the feeling of the directors that it reflected great credit on the skill and ability of their general manager that he had been able to show such results in face of the difficulties he had had to contend with. There were some items in the account that he would like to call their attention to especially. On the asset side of the balance-sheet they would see that the buildings, machinery, and plant, after allowing for £5,000 to be written off, were £183,000, as against £135,000 in the previous balance-sheet. That was an increase of £47,000, and had been caused by the increase in the business of the company. If they had not had the increase they could not have had the work. The cable drums had increased by £5,000, and if they had not had the drums they could not have wound the cables upon them, and that showed also what a large increase there had been in the business. Stock in hand was £69,000 against £43,000, and expenditure on contracts in course of execution £68,000 against £62,000. Sundry debtors showed an increase of £118,000, and the cash was £11,000 against £21,000. Shares in other companies were £7,545 against £5,600, an increase of about £2,000. That was a figure which fluctuated very much in the

balance-sheet. They always tried to keep it as low as possible, but now and then they were bound to take a few shares to secure contracts. On the other side the only item to call for attention was bills payable, £142,955; and trade creditors and other liabilities, £80,000. These two items added together compared with £119,000 in the previous balance-sheet, but as he had pointed out, the sundry debtors on the other side of the account had increased by £118,000, so that the difference was on the right side. The profit and loss account being showed a profit on manufacturing of £64,000, as against £59,000, and after paying all expenses, including repairs and maintenance of the plant, and the removal of the machinery to the new building—which was an item he did not suppose would occur again—they carried down a balance of £41,966, to which had to be added £6,212 brought forward. From this they had to deduct interest on debentures, £4,050; dividend on preference shares, £4,866; interest paid on new ordinary shares, £933; depreciation on plant and machinery, £5,000; and depreciation on furniture, £107. So that there was an available balance of £33,221. It was proposed to pay a dividend at the rate of 10 per cent. on the ordinary shares, and a bonus of 5s. per share; to place £10,000 to reserve, and carry forward £8,221 13s. 4d. The total payments to the holders of the original ordinary shares would be, therefore, as last year at the rate of 15 per cent. per annum. There was only one thing in the report on which he would make any observations, and that was as to the issue of the new preference shares. The business was increasing very largely, and they would remember that last year they issued 10,000 ordinary shares of £5 each at a premium of £5. That produced £100,000, and they might naturally suppose that £100,000 would last a considerable time. But if they took the increase in the property, and drums, and stock, and the expenditure on contracts, and debtors, it came altogether to £222,000. On the other hand, deducting the £100,000 reduction of costs, and the £104,000 increase of creditors, it would be seen that really they were £8,000 worse off than they were this time last year. The issue of new preference shares would be made as soon as the necessary arrangements could be made.

Mr. W. O. CALLENDER seconded the motion.

A SHAREHOLDER said that with regard to them being £8,000 worse off, the chairman did not say that the money had been spent in providing an establishment which was second to none, and that they were now in the position to do an enormous amount of business.

The CHAIRMAN said that what he pointed out was that they wanted money to carry on the business.

The report having been carried,

Mr. T. O. CALLENDER (managing director) said that they had had a good deal of trouble in the past year with regard to their premises, and in addition labour and everything else had risen. The chairman had given him great credit for the management of the business at Erith, but a great deal was due to the skill of the staff. The demands upon them were increasing, and their customers were asking for more and more, and they were dealing with heavier sizes than they had ever done in the past. It was for that reason that it would always be necessary to go on improving and extending their work. But they did not wish to put any more money than was absolutely necessary into bricks and mortar and machinery. With regard to the business of the year they had had no reason to be dissatisfied, for they had got more than their fair share of the work that had been going, and they had nothing to grumble about the prices they had received.

Replying to a vote of thanks, the CHAIRMAN expressed the belief that the current year would be quite as successful as the past.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

THE half-yearly meeting of this company was held at Cannon Street Hotel yesterday, when a resolution was passed sanctioning an interim dividend of 2½ per cent., or 5s. a share.

The Hon. MARSHAM, who presided, after explaining the alteration in date of holding the meetings, said that the company's contracting business showed an increase compared with the same months in the previous year. In some lines there had been a considerable decrease, but that had been well balanced by increases in others. They had also had more submarine cable work to do. The *Silvertown* was now loading in the Thames, and would sail in a few days to lay about 1,000 miles of cable between Nova Scotia and New York. They hoped to complete that cable in time for the boat to return to England for the completion of the Waterville, Ireland, and Weston-super-Mare cable. The *Silvertown* had been overhauled. The *Dacia* had returned safely from her voyage to the West Indies, where she was employed in work which was mentioned at the general meeting. The *Buccaneer* is now on charter to the Western Telegraph Company. Whilst making favourable remarks on the business, he impressed upon them that competition was keen, the price of raw material was high, and coal was costing 25 per cent. more than in the spring of 1899. The expected litigation between the Dunlop Pneumatic Company and the Palmer Company, had been satisfactorily arranged and peace prevailed.

Mr. S. W. SILVER seconded the dividend resolution, and the meeting closed with the usual vote of thanks.

West India and Panama Telegraph Company.

MR W. ANDREWS (chairman) presided on Wednesday over the forty-sixth ordinary general meeting of the West India and Panama Telegraph Company, Limited, held at Winchester House, and, in moving the adoption of the report, said he was afraid the remarks he would have to make that day would throw a disagreeable light upon the present position of the British West Indian Islands. If there was any truth in the close connection which was said to subsist between the activity of the telegraph and the activity of trade and commerce, then the story they had to tell that day would not be a cheerful one. For instance, the receipts in the past six months had been £22,643 14s. 7d. as against £51,937 15s. 7d. in the corresponding period, showing a decrease of £29,294 2s. That was not one of the features they would have to dwell upon that day, because that very large receipt was quite abnormal, owing to the Spanish-American War, which revolutionised, so to speak, the receipts of 1898. A more proper comparison would be made with the last half of the year 1897. Even here, however, there was a reduction in the comparative revenues shown of £9,584 17s. 1d. There was no doubt that their present low receipts were owing to reductions in rates made in January, 1898, and February, 1899, coupled with paucity of business. In fact, the failure of low rates to stimulate business, owing to the deplorable sluggishness of trade and commerce in the West Indian Islands had caused diminished revenues. There was a falling off in the expenditure, which had been £21,432, as against £24,443, a decrease of £3,011. Practically their expenses were at about their lowest ebb, and it was owing to exceptional causes that the reduction had taken place; for instance, in repairs to cables there was a reduction of £611, which was a thing they could not control. No doubt the shareholders had observed that in the High Court Mr. Justice Farwell had decided against them in the action which had been brought by the Cuba Company against them. As there would be an appeal, however, it would be improper for him at that stage of the proceedings to make any observations. The fact was, that in the first Court the verdict had been against them, and now they must go and do the best they could in the Court above. A feature that was disappointing was, that the legislature of the colony of Barbadoes had reduced their subsidy £1,000. Now their total subsidies were only £13,100 per annum against £24,000 per annum in the year 1896. Of course, they could see that when trade and commerce in the islands was bad, it was natural that the Government should wish to save money, and although it was unpleasant to them, yet it was not an unnatural view for the Government to take. If they looked at the state of their accounts, they certainly gave them instructive material, and threw a very strong light on the West Indian decadence. Taking six years ending 1882, their average receipts were £76,279 per annum. The year 1883 was a record year with them, and the total takings amounted to £97,859. Then for the eight years ending 1890 the receipts averaged £90,758, and it was during that time that the reserve fund was accumulated. From 1890 the receipts had continued to fall until 1897, when they amounted to only £70,439, and excluding the year of the war and coming to 1899, the total only reached £56,594 From that they could see that something must be done for the West Indian Colonies. During late years they had been unable to add to the reserve fund from earnings. Another remarkable fact was that in 1897 the intercolonial traffic—that was the traffic between the islands—was 533,639 words, and notwithstanding reductions in 1899 the words had actually dropped to 163,714 words. He must add that the words transmitted in 1899, after the large reductions as compared with the corresponding period of 1897, did show an increase amounting to something like 42,000 words, but here again unfortunately there was a decrease at the British station on intercolonial traffic of no less than 2,016 words. In fact, as far as they could see, the British West Indies were getting decidedly the worst of it. The directors had been compelled to call the attention of the Government to the present position of the company, and had declared very clearly that they could not possibly continue. The directors were urged to reduce the rates so as to do something to encourage the West Indian trading commerce, but unfortunately nothing had come of the measures but disappointment. The directors were anxious to work at the lowest possible tariff, but in the meantime they must be subsidised. The deputation were accorded a courteous reception, but of course they could not tell what the result would be.

Mr. H. HOLMES seconded the motion.

Some discussion followed, and MR. BERRS said he thought if they were in the hands of the Cuba Company they might as well face liquidation, and try and make terms with other companies.

The CHAIRMAN replying to various questions, said that while it was true that they might pay off the debentures by using the reserve fund, and this would save them some £900 a year, yet he thought it would not be a wise thing for them to do, because in the event of a breakdown in the line, when they went to the public to try and raise money for debentures they might be left high and dry.

The report was agreed to.

Isle of Man Tramways Company,

A MEETING of the shareholders of the Isle of Man Tramways and Electric Power Company, Limited, was held on 24th ult. at Derby Castle, Douglas. Mr. JOHN R. COWELL presided, and explained that, after the failure of Dumbell's Bank, he found the company's finances in a very difficult position. He had entered, reports the *Financial News*, into negotiations with English financiers to provide the additional capital which was required to meet the company's necessities, but had been refused both in London and in Liverpool. He partially attributed this failure to Messrs. Turquand, Youngs and Co.'s report on the affairs of the company, which he considered was very severe, and, in some particulars, unfair. They required some £150,000 to meet the outstanding liabilities. The capital should long ago have been increased, but the board had absolutely confided in Mr. Bruce, who always promised to float additional capital when the market was favourable.

Eventually a committee of shareholders and creditors was appointed to confer with the directors on the best course to be followed in the company's interests.

Westminster Electric Supply Corporation, Limited.

AN extraordinary general meeting of this corporation was held at Eccleston Place, S.W., on Monday, when the subjoined resolution, which was passed at the recent extraordinary general meeting of the company, was confirmed as a special resolution:—

"That the capital of the corporation be increased from £899,500 to £550,000, by the creation of 80,100 ordinary shares of £5 each, and that such shares be issued at par to the shareholders *pro rata* according to their holding in the company.

The resolution was moved by Mr. R. W. WALLACE, Q.C., and seconded by Mr. BROWNE MARTIN, and carried *nem. con.*

A SHAREHOLDER asked whether it was a fact that some members of the board had, since the last meeting, sold the greater part of their shares because of the likely effect of the resolution to issue at par.

The CHAIRMAN said he thought the directors were not called upon to give information of their private affairs. There was no diminution in the directors' feelings as to the prosperity or soundness of the company, although some of them were adverse to the course which had been pursued.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to Edison & Swan United Electric Light Company, Limited, provisional certificates for £100,000 5 per cent. second debenture stock.

The Stock Exchange Committee has been asked to appoint a special settling day in—Nernst Electric Light, Limited—180,000 vendors' ordinary shares of £1 each, fully paid, Nos. 1 to 180,000, and 25,000 vendors' 7 per cent. non-cumulative preference shares of £1 each, fully paid, Nos. 115,001 to 140,000.

Oswestry Electric Lighting and Power Company, Limited.—The annual meeting of this company was held at Oswestry last week, Mr. Bremner Smith presiding in the absence of Mr. A. W. Corrie. The report was adopted, and a 4 per cent. dividend declared.

New General Traction Company, Limited.—A confirmatory meeting which had been arranged for Tuesday last was postponed for a few days.

Castner-Kellner Alkali Company.—The meeting of this company was held in London yesterday (Thursday). A report will appear next week.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending May 26th, 1900, were £413 11s. 4d.; receipts for corresponding period, 1899 (Whitsuntide Holidays), £1,435 16s. 5d.; aggregate for half-year to date, £5,528 17s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending May 25th, 1900 were £3,169 5s. 8d.; corresponding period, 1899 (Whitsuntide Holidays), £3,816 18s. 9d.; decrease, £647 13s. 1d.

The City and South London Railway Company.—The receipts for the week ending May 27th, 1900, were £1,355; ditto May 28th, 1899, £912; increase, £443. Total receipts for half-year, 1900, to date, £26,319; corresponding period, 1899, £22,234; increase £4,085. Miles open May 27th, 1900, 3½; May 28th, 1899, 3½.

The Dover Corporation Tramways.—The receipts for the week ending May 26th, 1900, were £207 17s. 1d.; May 26th, 1899, £214 6s. 1d.; decrease, £6 9s. 0d. Total receipts to date, 1900, £3,402 4s. 6d.; corresponding period, 1899, £3,260 8s. 7d.; increase, £141 15s. 11d. Miles of track open, 1900, 8; 1899, 8. Car miles run, 1900, 4,984; 1899, 4,924. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, May 25th, 1900, were as follows:—D. U. T. Co., horse cars £55 10s. 2d.; ditto, electric cars, £3,494 13s. 5d.; D. S. D. Co., electric cars, £823 9s. 5d.; total, £4,373 13s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,265 8s. 7d.; ditto, electric cars, £1,357 5s. 8d.; D. S. D. Co., electric cars, £1,056 0s. 6d.; total, £4,678 14s. 4d.; decrease, £305 1s. 4d. Aggregate to date, £84,649 19s. 10d.; aggregate to date last year, £71,879 7s. 9d.; increase to date, £12,770 12s. 1d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending May 27th, 1900, amounted to £1,429; corresponding week last year (includes Bank Holiday), £1,825; decrease, £396. Total traffics from January 1st to date, £29,657; corresponding period 1899, £28,848; increase, £809. Miles open, 6 57 chains.

The South Staffordshire Tramways Company.—The receipts for the week ending May 25th, 1900, were £710 17s. 3d.; May 26th, 1899, £948 6s. 5d. Aggregate receipts for 21 weeks, £13,639 16s. 0d.; last year, £13,264 18s. 8d.

STOCKS AND SHARES.

Wednesday Evening.

THE rapid way in which the war in South Africa is now progressing has had a marked effect upon the Stock Exchange. Whereas the arrival of expected good news has all along failed to stimulate markets to any extent, the businesslike way in which Lord Roberts is conducting the campaign is exercising a wonderful influence for better prices. Of course, the conclusion of the war will, for one thing, lay to rest the skeleton in the dearer money cupboard, because no such fresh National War Loan as was talked about would then need to be looked for. This one fact must tell powerfully with investors, to say nothing of the quieting down of the unsettlement which for the last eight months has led the public to shun Stock Exchange markets, and leave its money on deposit with the banks at whatever rate of interest those institutions care to pay.

So far the electrical markets have been undisturbed by the stirring news that this week has brought. The supply department is almost quieter than ever, and the dearth of business is reflected in a couple of falls. In the telegraph section a further sharp drop in West Indis and Panama Telegraph descriptions is the principal feature, while in the miscellaneous markets Central Londons' rise of 10s. is the only noteworthy item.

In view of the likelihood of investment securities advancing in public favour as soon as the war has become a matter of history, it is not out of place to note the return which can be obtained from the more active shares in the electrical departments. We have therefore compiled a few brief lists, which may be of considerable use to the investor who is puzzled to know in what direction his capital can be most safely, or more profitably, placed. We will this week confine our attention to the Ordinary shares of the best known supply undertakings. The calculations are worked out upon the basis of the dividends paid for the last twelvemonth in each case.

COMPANY.	PRICE.	LAST YEAR'S DIVIDEND PER CENT.	YIELD PER CENT. AT PRESENT PRICES.
Brompton and Kensington ..	7½	6	4
Charing Cross	9	9	5
City of London	10	4	4
Metropolitan	14	5	£3 11 3
Notting Hill	16	7	4 7 6
St. James's and Pall Mall ..	15	14½	4 16 3
Westminster	15	13	4 6 8

It will be seen at a glance that there is every room for a rise in Notting Hill, St. James's, and Westminster shares, even if the uncertain outlook ahead of the Charing Cross Company should prevent the advance in price in its shares which seems justified by the yield obtainable.

The Westminster Electric board have now issued their circular with reference to the new shares, and it remains to be seen whether present proprietors will elect to sell their old in order to pay for the new shares, or renounce their rights of applying for the latter by selling them outright. A market for the new shares has already been established, and the nominal price is 7 to 7½ premium, which is about £1 below the quotation for the current lot. If precedent should prove a trustworthy guide on this occasion, the probability is that a good many new shares will come on the market, as shareholders who are unwilling or unable to take up their allotments will be only too glad to take the substantial premium which they can now secure by selling. Nevertheless, it would seem wiser to pay for the new shares, a better price in the future being almost a certainty.

Electric Traction has of late been bulking largely in the public eye, partly by reason of the discussion that has arisen at St. Stephen's with regard to the control of local light railways by a group of powerful combinations, such as, for instance, the British Electric Traction Company. Various schemes are also under way for vigorously developing the system, not only over London, but the provincial centres as well, Lancashire being one of the counties which will soon be covered with the new lines. The market in Electric tramways continues somewhat dull. British Electrics are steady at 16, dealers being a little fearful of making prices in more than a few shares at a time pending the declaration of the dividend which, as we mentioned a fortnight ago, is expected to be at the rate of 8 or 10 per cent.

Metropolitan District stock shows no indication of improving, despite the successful running of the experimental electric train between Earl's Court and High Street, Kensington. Central Londons are better, as we remarked in our introductory paragraphs, and the settlement on Tuesday disclosed some shortness of shares. Central Londons are not fitted for "bear" attacks, and if any liberties are taken with them, it should prove a good thing in the long run for holders.

The marked weakness of West Indian and Panama Telegraph Preferences is due to the dissatisfaction felt by shareholders at the recently-issued report, which shows that the reserve fund has had to be drawn upon in order to pay the dividends in full. This apparently has been caused by the falling off in receipts which ensued after the Hispano-American war. For the same reason Cuba Telegraph shares are also flat, as we pointed out last week, and another drop has been marked. Eastern Telegraph Preference declined a point upon a seller coming into an unwilling market.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, May 23rd.	Closing Quotation, May 30th.	Business done during week ended May 30th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	62 — 65	62 — 65	64½	62
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	114¼—115½	114½—115½	115½	114
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	13⅜— 14¼	13⅜— 14¼	14	13⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	...	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103½	102⅜
16,000	Cuba Telegraph	10	7 %	8 %	7 %	7½— 8½xd	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	17 — 18 xd	16 — 17	16	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101—105%	101 —105%	...	...
60,710£	Direct United States Cable	20	3¼%	3½%	3 %	11½— 12	11½— 12	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	150 —155	150 —155	153½	150½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —101	97 —100	99⅜	98
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	114	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15⅜— 16¼	15½— 16	16 3/16	15⅜
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	100 —103	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	112 —117	112 —117	...	...
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 8,000, red. 1909	100	...	...	...	100 —103	100 —103	100½	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	5¼%	11½— 11⅝	11½— 11⅝	11½	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15¼— 15⅜	15¼— 15⅜	15⅜	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	12½%	...	32 — 34	32 — 34	33¼	32½
86,800	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 57	53 — 57	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅜— 5⅛	4⅜— 5⅛	5	4 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	12 — 14	12¼	12⅛
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	5⅛	5
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 99	98 —101	99½	97¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	15/16— 1 1/16	15/16— 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	102 —105	102 —105	...	...
11,889	Reuter's	8	5 %	5 %	...	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	124 —129	...	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4⅜— 5¼	4⅜— 5¼	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜— 15½	14⅜— 15½	15½	14⅞
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	105 —108	105 —108	...	...
88,321	West India and Panama Telegraph	10	2¾%	2 %	...	¾— 1	¾— 1	1 1/16	1 1/16
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	9 — 9½	7 — 8	7½	7⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	7 — 8	6½— 7½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	104 —107	106	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...		8¼— 9½	8½— 9½	8 1/16	8 1/16
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	8½— 9½	8½— 9¼	9 1/16	
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅝	5 9/16
34,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	6 %	6½— 7½	6½— 7½	...	...
150,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	...	..	108 —111	108 —111	110½	
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	4 %	10— 11	9½— 1 1/2	10	9⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12⅜	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	..	122 —127	122 —127	..	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9½— 10½	9½— 10½	9⅝	9½
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	11½— 12½	12½	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	109 —112	110 — 113	112	111½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock ...	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 2	1½— 2	...	...
49,840	Do. do. do. 6 % Pref.	5	...	6 %	...	4 — 4½	4 — 4½	4⅝	4½
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	100½	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13½— 14½	13⅝	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	114 —117	114 —117	...	...
220,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15½— 16½	16½	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	14⅞	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9¼	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. Do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	14½— 15½	14½— 15½	15½	14⅞

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation May 23rd.	Closing Quotation May 30th.	Business done week ended May 30th, 1900. Highest.	Lowest.
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2⅞— 3¼	2⅞— 3¼	3	2⅞
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	15½— 16½	15½— 16½	16⅛	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅞	12 11/16
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	...	...
85,000£	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅞— 1	⅞— 1	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	13/16— 14/16	13/16— 14/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6½	6 — 6½	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅞— 2	1⅞— 2	1⅞	1 13/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —113	109 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —105	103 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	14½— 15½	14½— 15½	15½	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5⅞	5½
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —116	112 —116	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10¼	10¼
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5¼	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
855,000	City and South London Railway	Stock	1⅛%	2⅛%	1⅛%	61 — 64	61 — 64	63⅛	63
37,500	Do. do. Ord. shares, Nos. 22,501 to 60,000 ...	10	...	...	...	5¼— 6¼	5¼— 6¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 103	103	101
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3¼— 4¼	3¼— 4¼	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 95	93 — 95	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2 — 2¼	2 — 2¼	2¼	2 1/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	3 1/16	2⅜
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 11	10 — 11	...	...
80,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13¼— 14¼	13¼— 14¼	13⅜	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅜	5¼— 5⅜	5 1/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅝	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3½%	8 5/16— 8 9/16	9⅛— 9½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13¾	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 38	34 — 38	36½	34⅜
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...	5	...	8 %	12 %	11½— 12½	11½— 12½	12⅛	12
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	100 —103	101 —104	101	100

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 103—107.
National Electric Free Wiring, 12/6 paid. ⅜—⅝.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10½—10⅞.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7 — 8. Debentures, 100—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 18.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (May 24th, 1900).

MARKET QUOTATIONS, Wednesday, May 30th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	29/-	29/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	39/-	40/-	1s. dec.
a Ammonia, Muriate (crystal) .. per ton	£34	£34	..
a " " .. .. per ton	£31	£31	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£17	£16 10	10s. inc.
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£26	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	4d.	4d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£25	£25	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	3¼d.	3¼d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£80 to £150	£80 to £150	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c " Tube (brazed) .. .. per lb.	10¾d.	10¾d.	..
c " " (solid drawn) .. per lb.	9d.	9d.	..
c " Wire, basis .. .. per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed) .. .. per lb.	11¼d.	11¼d.	..
c " " (solid drawn) .. per lb.	11¼d.	11¼d.	..
g Copper Bars (best selected) .. per ton	£85	£86 to £87	dec.

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£85	£86 to £87	dec.
g " Rod .. .. .. per ton	£85	£86 to £87	dec.
c " (Electrolytic), Bars .. per ton	£91	£93	£1 dec.
c " " Sheets.. per ton	£93	£92	£2 dec.
c " " Rod .. per ton	£84	£85	£1 dec.
c " " H. C. wire per lb.	9½d.	9¾d.	¼d. dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
m German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	8/- to 8/6	8/- to 8/6	..
h India-rubber, Para fine .. .. per lb.	3/9½ to 3/10	3/11 to 4/-	dec.
f Iron, Charcoal Sheets .. .. per ton	£18	£18	..
f " Pig (Cleveland warrants) per ton	69/6	73/8	4/2 dec.
f " Forgings, according to size per ton	From £11	From £11	..
f " Scrap, heavy .. .. per ton	70/- to 72/6	70/- to 72/6	..
f " Wire galvanised No. 8 .. per ton	£13 10	£13 10	..
g Lead, English Ingot .. .. per ton	£17 to £17 8 9	£16 15 to £17 2 6	inc.
g " " Sheet .. .. per ton	£18 10	£18 10	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£9 10	£9 10	..
d Mica (in original cases), small .. per lb.	3d. to 9d.	3d. to 9d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. .. per oz.	£8 12	£8 12	..
p Silicium Bronze Wire .. .. per lb.	10¾d. to 1/1	10¾d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£141 to £141 10	£140 to £141	inc.
g " foil .. .. per lb.	1/9	1/9	..
n " wire Nos. 1 to 16 .. .. per lb.	1/9	1/9	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	8¼d.	8¼d.	..
j " Best Flax, 8 lea. .. per lb.	6d.	6d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j " Russian, 10 lbs. .. per lb.	5½d.	5½d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27 5 nett.	£27 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Rolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. F. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE CALCULATION OF DISTRIBUTING SYSTEMS OF ELECTRIC TRACTION UNDER BRITISH CONDITIONS.

By H. M. SAYERS, Associate Member.

(*Paper read May 3rd, 1900.*)

(*Continued from page 896.*)

MULTIPHASE DISTRIBUTION.

Assume one station, at T (Diagram D), generating plant to give 3-phase current at 2,500 volts. Using 3-wire mains, the current per conductor will be

$$\text{KW.}\ \frac{1{,}000}{2{,}500} \times \sqrt{3} = (\text{KW.}\ \cdot 23)\ \text{amperes.}$$

The cables will be of the 3-core twisted or equivalent type, and on this account as well as the larger amount of insulating material needed, their cost per ton of copper will be higher. The depreciation will also be at a higher rate. First, because the scrape price will be a lower proportion of total value; and second, because high-tension cables certainly suffer more from faults than those under low tension. Therefore R is taken at 9 per cent. p at £208, the other values remaining as before—

$$p = \frac{9 \times 58{\cdot}45 \times 208 \times {\cdot}045 \times 91}{100} = 448 \text{ and } T = 21{\cdot}2,$$

the density $\frac{21{\cdot}2}{{\cdot}045} = 470$ α per square inch, and the drop per mile 21·2 volts. The loss in any 3-wire 3-phase conductor will be $3C \times 21{\cdot}2$ per mile, where C is the current as given above for the load transmitted, so that the loss per KW. delivered to the cables will be ·69 × 21·2 = 14·62 watts per mile, or 1·46 per cent. per mile.

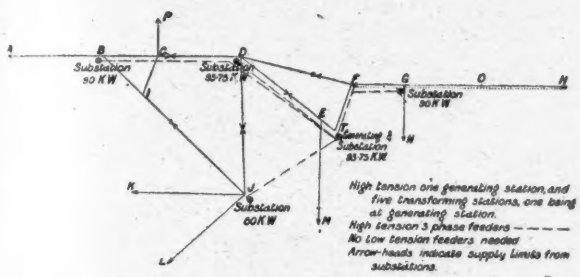


DIAGRAM D.

Transformers will be required at G, T, D, J, and B, the output needed being as follows:—

From G	...	12 cars	...	90 KW.
T	...	12·5	...	93·75
D	...	12·5	...	93·75
J	...	8·0	...	60
B	...	12·0	...	90
Total		57·0 cars	...	427·5 KW.

These loads are allocated on the simple consideration that each transformer should supply half-way to its neighbour in each direction, and represent the energy delivered to the cars. Loss on the low-tension side has to be added to get the gross output, which may be taken at 450 KW. Hence at four of the five stations 100-KW. sets, and at the other a 65 or 70-KW. set would suit. But allowance must be made for spares and for unusual demands due to local pressure or bunching of traffic. Whether it would be better to put down two 100-KW. or three 50-KW. sets at the larger stations should in every case be determined on comparison of the cost of the different sized sets with their switch gear, the probabilities of exceptional traffic, and other fairly obvious considerations. It might well happen that the two larger sets would cost little more to instal than the three small ones, and that the extra flexibility would be well worth the cost. Assuming, however, that the three-set plan is adopted, it will be necessary to instal transformers to a total capacity of 705 KW.

The high-tension feeders to these sub-stations will be as follows, assuming a full-load efficiency of transformation of 85 per cent, or rather a constant loss during operation at the rate of 15 per cent. of the rated capacity, and 2,500 volts pressure:—

Line.	Miles.	Amperes.	Sections sq. in.	Tons Cu.	Value.	Loss in watts.
T G	2·15½	3 × 24·2	3 × ·051	2·93	£620	3,307
T D	2·35½	3 × 25	3 × ·053	3·27	690	3,736
T J	2·15½	3 × 16·1	3 × ·034	1·95	406	2,201
T B	5·25	3 × 24·2	3 × ·051	7·30	1,518	8,080
	11·90			15·50	£3,224	17,324

The loss in the transformers on the above assumption will be 15 per cent. × 470 = 70·5 KW. With this disposition of sub-stations no track feeders are needed, and secondary trolley feeders can also be dispensed with, as the trolley wires of usual size will not drop more than 10 volts average all over the system, the worst point being H, where the drop will be 32 volts. The trolley wires leading east of G, from T to E, and B to C, will be somewhat heavily loaded, and for reliability of service it might be well to use some auxiliary feeders, or heavier trolley wires on these sections, but this will not be necessary for distribution efficiency.

The distribution losses will then be:—

In H.T. cables	...	...	...	...	17·3 KW.
In transformers	...	...	...	...	70·5 „
In trolley wire	...	...	...	...	8·55 „
					96·35 KW.

and the generating plant must be able to give out 524 KW. Overall efficiency of the system being thus $\frac{427{\cdot}5}{524} = 81$ per cent. nearly.

This is a little higher than Mr. Parshall's figures for Dublin. No addition has been made to the cable losses for power factor being less than unity, and it appears probable on the rather scanty information obtainable in this country that full justice is done to current practice in the above result. To obtain the annual cost of this distribution, proper charges on the transformers, including attendance, have to be estimated. This again is not easy, for the prices of such plant are not readily obtainable, but for the present purpose market prices are not essential. There is good authority for the statement that for smaller sizes than 200 KW. motor-generators perform better than static transformers and rotary transformers, therefore motor-generators are assumed in the following figures:—

Motor generators to capacity of 705 KW. at £15 per KW. with switch-gear	£10,575
Four sub-stations and sites at £80 each	320
	£10,895

Interest, depreciation, and repairs, 12½ per cent. on £10,575 and 2½ per cent. on £320	£1,329
Attention to each set, say 3s. per week or £7 16s. per annum, 15 sets	117
Oil, brushes, and sundries, say £2 10s. per annum, per set...	37
Total per annum	£1,483

The distribution costs then work out as follows:—

H.T. conductors, $C^2 R$ loss value $\frac{17{,}324}{58\ 45}$	£295
Interest on cables (cost £3,224)	290
Loss in transformers $\frac{70{,}500}{58\ 45}$	1,205
Loss in trolley wire, 8,550 at 48·5 per £1	176
Interest and attention and stores on transformers	1,483
	£3,449

This sum amounts to ·352d. per unit delivered to the cars, making the cost of the power there 1·102d. per unit, or £10,875 annually. This is ·217d. per unit, or £2,124 per annum in excess of the two-station direct supply, and £939 in excess of the one-station direct supply, as will be shown by the tabulated results below.

Obviously a high tension station cannot generate at a lower cost per unit than a low tension station on the same site, but the result of this investigation goes to show that if in the neighbourhood a site exists with such advantages that the cost per unit of the power generated there and delivered to T, or equal point, will be under ·53d., instead of ·75d., there will be an advantage in using the transformer system. In other words, this calculation shows what saving in generation costs is required to justify the use of a transformer system and a high tension station.

The capital expenditure is not much reduced, as the total for cables and transformers amounts to £14,119, which lies between the costs of cables and boosters in the two low tension systems discussed. There would be also a considerable saving in cable laying expenses, due to the lighter cables and smaller number of ways needed. This point and the difference between the capital outlay in the stations are foreign to the present subject, but must of course be keenly studied in practical designing. It should, however, be noted that the load factor is of great importance, and that the assumed conditions are rather more favourable to a transforming system than the conditions usually found in practice, for the reason that the losses in transformers are largely independent of the load, and that sufficient transformer capacity must be kept in use to provide for the maximum demands during any given period. The device of dividing into small sets and putting them in as needed cannot be carried far for several reasons. Hence the losses are more nearly those due to the maximum than to the average load over any given period. Cable losses on the other hand vary with—and as the square of—the actual load, consequently a poor load factor tells much more against the efficiency of transformers than of cables.

The small proportion of the total losses due to the high tension transmission indicates the small effect of distance on the overall efficiency, so that the radius within which the advantages of a specially favourable position for a generating station may be utilised is not severely limited. For lines on which multiphase motors and the consequent increased number of overhead wires are practicable, it is apparent that the advantages of this system are very great. Only

static step-down transformers being required, the overall efficiency can be kept high, and attendance at sub-station made very trifling. This is hardly a live subject in this country yet, but the economies of distribution on such a system can be worked out on the same lines as here put forward when occasion shall arise and the regulations to be complied with shall be known.

The principal figures in the three schemes above worked out are here tabulated for comparison:—

	Low tension.		High tension.
	1 station.	2 stations.	1 station.
Distribution costs, annual	£2,510	£1,325	£3 449
Ditto per unit at car	·266d.	·135d.	·352d.
Generation and distribution, annual	£9,936	£8,751	£10.875
Ditto per unit at cars	1·016	·885d	1 102
First cost cables and transformers...	£16,593	£8,788	£14.119
Miles of cables	25 64	22·87	11 90
Miles of trenching	12 025	13 85	9 55

APPENDIX No. I.

CALCULATION OF MOST ECONOMICAL CURRENT DENSITY.

Rate of ohmic loss. $C^2 r$ watts, where C = current in amperes and r = resistance in ohms.

Rate of interest and depreciation loss in £ sterling per annum $= \frac{R}{100} p\, m\, a +$ constant. Where R = rate per cent. per annum of interest and depreciation; p = price in £ per ton of copper in the form of cable, m = tons of copper per mile of conductor of one square inch cross-section; a = cross-section of conductor in square inches, so that $m\,a$ = tons of copper per mile; and the constant represents such costs of laying and other expenses as are practically dependent only upon the length of cable laid and independent of its size. To add these losses they must be equated for definite conditions of load and period of use. For this purpose, assume the period to be one year; the load to be steady and lasting for a certain fraction of every day $= \frac{h}{24}$. A certain cost per Board of Trade unit delivered to the conductor $= n$ pence.

Then £1 per annum is the cost of $\frac{240}{n}$ Board of Trade units wasted per annum, and the rate of waste in watts which gives such a loss is $\frac{240{,}000}{h\,n \times 365}$, or $\frac{657{\cdot}5}{h\,n}$. Call this w. It is the number of watts which, wasted during all the working hours in a year, will cost £1.

Then $\frac{R}{100} w\, p\, m\, a$ is the interest cost of the cable expressed as a loss in watts during working hours, and the total rate of cost of distributing the current C through the cable is $y = C^2 r + \frac{R}{100} w\, p\, m\, a$.

The resistance of the conductor obviously affects the value of the two quantities making up the total loss in opposite ways, and the problem is to find the value of r which makes y least. Consider a cable of 1 mile in length. If the resistance of 1 mile of copper conductor of 1 square inch cross-section is $\cdot 045\, w$, then $a = \frac{\cdot 045}{r}$, and the second item of the total cost $= \frac{R\, w\, p\, m \cdot 045}{100\, r}$.

Since this has been equated to a rate of loss in watts it may be written

$$\frac{C_2^2 r^2}{r} = \frac{t^2}{r} \text{ where } t = C_2 r,$$

C_2 being such a current as would produce the required loss in watts on traversing the resistance r. We then get

$$y = C^2 r + \frac{t^2}{r}, \text{ whence } \frac{dy}{dr} = C^2 - \frac{t^2}{r^2},$$

and this is a minimum when

$$C^2 = \frac{t^2}{r^2} \text{ or } r = \frac{t}{C}.$$

This is the Kelvin law, since when this is the case $C_2 = C$, and the two items of cost representing ohmic loss and interest are equal.

The most economical current density therefore is

$$\frac{C}{a} = \frac{t}{\cdot 045}, \text{ where } t = \sqrt{\frac{R\, w\, p\, m \cdot 045}{100}},$$

and the most economical rate of voltage drop is t volts per mile.

If the load is not steady but varies in a known way, then C^2 = the mean square of the current in respect to time, and C = the square root of that.

In the expression for t^2, $\frac{R\, p\, m}{100}$ is the annual cost of one mile of cable of one square inch copper section, *i.e.*, of 9·1 tons copper weight.

Then $\frac{R\, p\, m\, w \cdot 045}{100}$ may be written $\frac{\cdot 41\, R\, p\, w}{100}$ or $\cdot 0041\, R\, p\, w$

and the most economical current density written

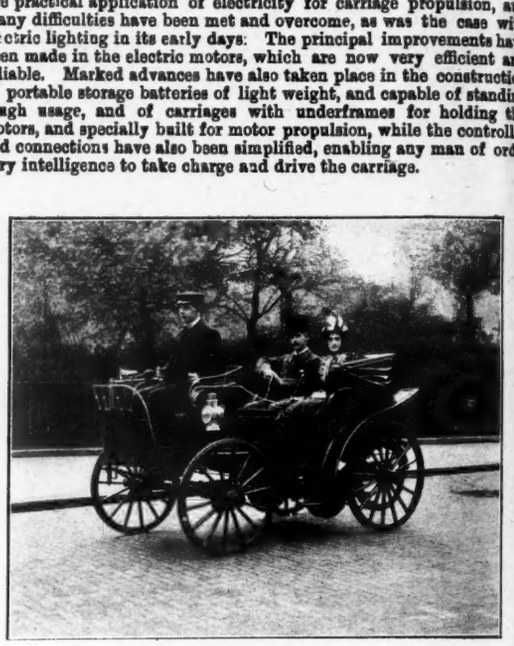
$$\frac{C}{a} = \frac{t}{\cdot 045} = \sqrt{\frac{\cdot 0041\, R\, p\, w}{\cdot 045}}$$

and a table of such densities for various values of the product $R\, p\, w$ can be readily formed.

(To be continued.)

ELECTRIC MOTOR CARRIAGES.

DURING the last seven years many inventors have been at work on the practical application of electricity for carriage propulsion, and many difficulties have been met and overcome, as was the case with electric lighting in its early days. The principal improvements have been made in the electric motors, which are now very efficient and reliable. Marked advances have also taken place in the construction of portable storage batteries of light weight, and capable of standing rough usage, and of carriages with underframes for holding the motors, and specially built for motor propulsion, while the controller and connections have also been simplified, enabling any man of ordinary intelligence to take charge and drive the carriage.



JOEL ELECTRIC CARRIAGE

OUR illustration shows one of the latest forms of electric carriage, constructed on the system and patents owned by the National Motor Carriage Syndicate.

There are two small electric motors driving the two back wheels of the carriage by ordinary link bicycle chains, acting directly from a small sprocket pinion on the motor axle to a larger sprocket wheel fixed to the spokes of the carriage wheel; these chains are adjustable as in a bicycle, and are as easily attended to. The motors are fixed on an independent and springy underframe, and as each drives separately, there is no necessity for balance gear. Two sets of batteries drive these motors, and are placed out of sight, half under the front seat, and half under the back seat, thus distributing their weight.

The steering and electric control are very simple, and there are good brakes; should one set of the batteries or one of the electric motors from any unforeseen cause become damaged, the other set of batteries and the other motor can be used to drive the carriage.

This system allows a very light construction, and an elegant form of carriage to be used. The carriage runs easily, without vibration or noise, at quick speeds. The whole carriage, completely equipped, weighs considerably less than many previous electric carriages, and will travel greater distances at less cost for electric current, whilst any cyclist can steer it.

The electric motors are the invention of Mr. Henry F. Joel, A.M.I.C.E., and are each of 2 B.H.P. nominal. They work with 40 volts, run at 600 to 700 revolutions per minute, and weigh only 112 lbs. Each will give 3 B.H.P., so that 6 B.H.P. is available to drive the carriage.

The motors have been specially designed and constructed for carriage work, and are the result of many years of experience in making dynamos and motors. The armatures revolve outside the field magnets, instead of inside, as usual, and they act as fly-wheels to keep the motion of the carriage steady.

The field magnets of these electric motors have 12 poles, arranged uniformly round a circle, and are turned true to fit close inside the armature core. A central magnet coil is enclosed by the iron of the field magnets, on three sides, and thus utilises to the utmost the magnetising current.

The winding of the armature is exceedingly simple and efficient, being, in fact, of the ordinary "barrel" type turned inside out. Short pieces of square insulated copper wire, all of exactly equal length and resistance, are passed through holes in the iron core of the armature; they are then bent obliquely, and connected by the shortest

possible path one to the other at the ends, to form a wave-winding crossing the armature as many times in one complete coil as there are poles on the field magnets. When completed they form symmetrical flanges round the sides of the armature, with a minimum of non-active wire, an equal resistance in each coil, and little or no windage when revolving. The short bars can be easily taken out and replaced.

The advantages claimed for this armature are:—A maximum proportion of the winding is effective in induction, and a minimum absorbed in ineffective connections. This enables the motor to be of comparatively light weight and high efficiency, owing to the small waste in connections between the operative parts of the winding. The armature is very strong in construction, and will bear overloading 100 per cent., this last being a most important feature.

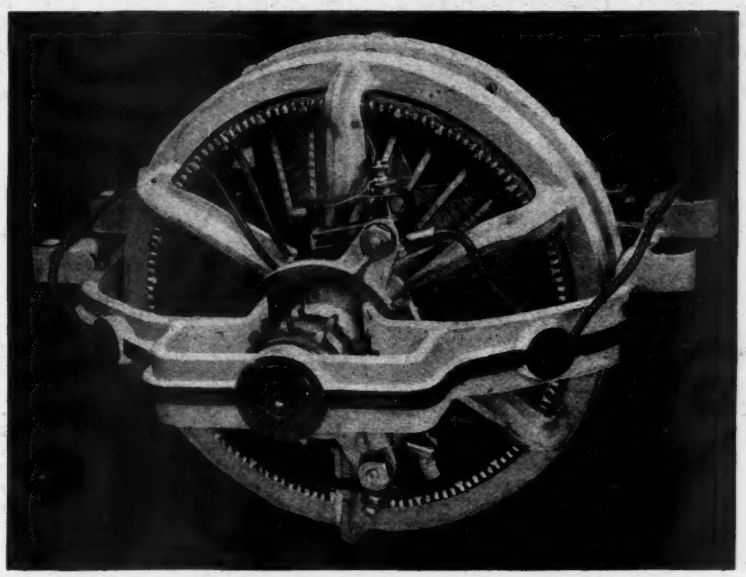
The axle carrying both the armature and field magnet is fixed at the front and back in a cradle frame of peculiar shape; the armature revolves on one long bearing, and the magnets are fixed to the axle.

The whole construction of the motor is unique, and is stated to be particularly well adapted for use on vehicles.

These motors are completely encased when in use, and run either way, backwards or forwards, without sparking or giving the slightest trouble.

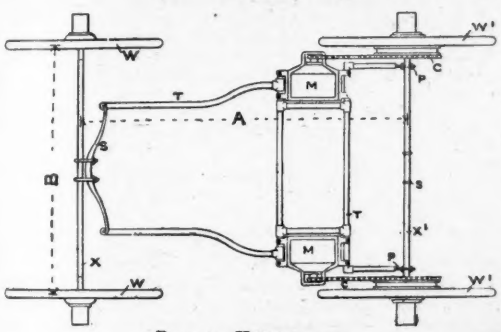
The following tests of a 2 B.H.P. (nominal) Joel motor show the efficiencies at different powers; speed, 650 to 700 revolutions per minute; pressure, 40 volts; weight, 112 lbs.

1	B.H.P. efficiency	70 per cent.	...	½ power.
2½	" "	77 "	...	
2	" "	85 "	...	Nominal and average power used in carriage.
2½	" "	87 "	...	
3	" "	89 per cent. to 90 per cent.		

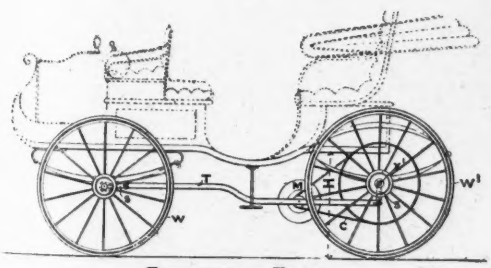


Joel Electric Motor with Internal Field Magnet.

The two motors are carried by an independent underframe, shown in the plan and side view of the carriage, of which the patents are owned by the syndicate. It consists of steel tubes, T, T,



Plan of Underframe



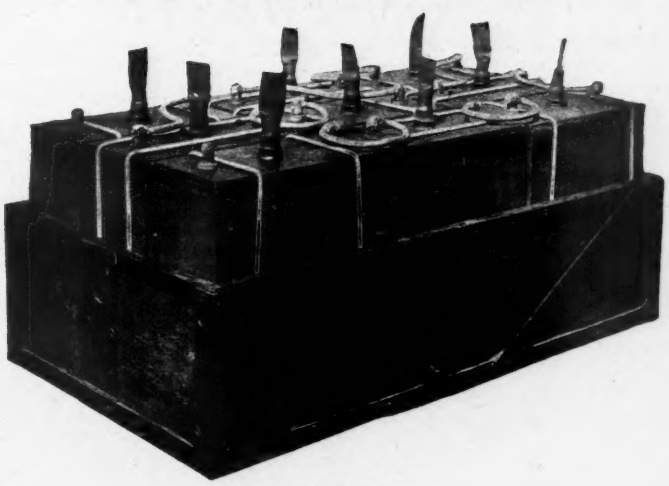
Elevation of Frame.

made into a rectangular frame fixed by half elliptic carriage springs, S, S, to the front and back axles, X, X¹, of the carriage wheels, W, W¹, thus forming a "perch pole," and giving a direct drive to the carriage wheels. The front spring of this frame is arranged horizontally, and fixed at the centre to the front axle, the back spring is vertical, and fixed to the centre of the back axle. Complete freedom of movement is thus obtained without strain to the underframe.

The motors, M, M, are fixed to the underframe by the lugs on the side of the cradle frame. The chains, C, C, connecting the two motors to the wheels, as shown, are put in line and adjusted for length by long threaded screw pins, P, P, and double nuts fixing the underframe to the vertical back spring. This underframe gives great facility for adapting electric propulsion, and can be fixed to any carriage. It is resilient, and prevents any shock or jar when starting or stopping, and being independent of the carriage body, any vibration at the motors is not communicated to the carriage. It also safeguards the motors from concussion when the carriage is passing over rough ground.

When the electric current is put on, the whole frame, with the motors, is at first lifted up a little against the back springs, and, as the carriage moves off, the frame returns to its normal position, thus the first rush of current is partly avoided as the armatures start at once, and, in addition, the weight of the motors in returning to their normal position, assists the carriage to move off quietly and without jar.

The batteries, "Rosenthal" type, are made up in portable sets of 10 cells in a tray, 40 cells in all. Each cell weighs 22 lbs. complete, and the total weight, with trays, is about 8½ cwt. The cells give 20 amperes discharge for seven hours, and will stand a discharge of 40 amperes without harm. The plates are of the pasted type, with special provision for expansion. They are enclosed in perforated cases, and are clamped together by rubber bands. These cells, after six years of experience in practical use, have been found to be very efficient and durable under the rough usage they have to stand in motor carriages, and they do not deteriorate or sulphate when out of use.



Set of Cells in Tray.

The working efficiency of the cells is high, 12 watt-hours per lb. of complete cell, and 16 watt-hours per lb. of electrodes being claimed. This is believed to be the highest efficiency hitherto attained, and the success of the carriage is greatly due to this.

The illustration shows a set of nine cells of this type in a tray, complete, and ready for use. These trays measure 13½ inches wide, 23 inches long, and 11 inches high, and, being portable, are easily put in or taken out of the carriage. Simple rubber nozzles are attached to each cell, and act as valves.

The following are the results of tests made by the Standardising

Institution at Faraday House on one of these cells and one of the type previously in use; the two cells were charged and discharged in series in order that they might be submitted to identically the same treatment as far as possible.

	Type of cell in use.	National Motor Carriage Syndicate cell.
Mean current discharge	20 amps.	20 amps.
Ampere-hours	120	143
Ampere-hours per kilo. of plates ...	12·0	17·3
Ampere-hours per pound of plates ...	5·45	7·9
Total weight of plates	22 lbs.	18·1 lbs.

This test shows an advantage of over 40 per cent. in favour of the cell of the National Motor Carriage Syndicate.

An electric commutating controller of very simple construction, the result of many experiments and trials in actual use, gives the carriage five speeds forward, viz.:—3, 6, 8, 10 and 12 miles per hour, and one speed of 3 miles per hour backwards.

The handle of this controller is arranged to be moved forward for going "forward," and *vice versâ*. The controller is also arranged to couple up the four trays of batteries in series for charging at 100 volts without loss.

The variation in speed is obtained as follows:—

1. Batteries in parallel	Motor armatures in series.	3 miles per hour.
2. Batteries in parallel	Motor armatures in parallel	6 miles at full power for hill climbing.
3. Batteries in parallel	Motor armatures in parallel varying power of fields.	8, 10 and 12 miles per hour.

The field magnet coils are separately excited, and can be altered at will. This has the advantage that the motors can be used as brakes, and the normal speed of the carriage of 12 miles per hour can be increased if desired to 20 miles per hour.

The carriage will run for 50 miles with one charge on good roads.

The weight of the carriage, fitted with motors, batteries, &c., is about 17 cwts., and the syndicate is making special light carriages, "Voiturettes," to carry two people for 50 to 80 miles, and weighing only 11 to 12 cwts. Mechanical band brakes are fitted for use in addition to the electrical brakes.

The carriage shown in the photograph has been run some hundreds of miles through different parts of this country and on the Continent. One test was a run from London to Potter's Bar, up Highgate Hill, Finchley Hill, and Barnet Hill. Another test was from Dover Harbour to the heights above Dover. It is absolutely safe and under perfect control in crowded streets.

The wheels of the carriage are 3 feet diameter, with solid rubber tyres; the wheel track is 4 feet 6 inches wide, with 5 feet 6 inches base, and the gear used is a Renold's chain with gearing of 8 to 1. The current required for hard level roads with three passengers is 30 amperes, or 15 amperes for each battery, at 40 volts, giving a full 1½ H.P. to the carriage at the speed of 12 miles an hour. When ascending inclines of 1 in 30 the current rises to 40 amperes, or 20 amperes each battery, and on inclines of 1 in 20, to 60 amperes, or 30 amperes each battery. In the voiturette made by the syndicate the wheels are 2 feet 9 inches diameter back and 2 feet 6 inches diameter front; front track 3 feet, back track 4 feet 6 inches; base 4 feet 6 inches. The voiturette is fitted with two 1-H.P. (nominal) motors, and a battery of 32 cells, weighing 7 cwts., and coupled as in the carriage described in the foregoing. The wheels, however, have "Grappler" pneumatic tyres, with roller bearings, and the whole carriage is very light and easy going. There is comfortable room for two, with a front seat. In this carriage the electric current required for propulsion is much less in proportion for the same weight than with the carriage illustrated—10 amperes only for each battery on hard level roads—and being a lighter carriage it will travel twice the distance and go much faster for the amount of electric energy required for the heavier type of carriage.

The carriages, motors, batteries, &c., are made for the syndicate by Messrs. Henry F. Joel & Co. at their London works.

PHYSICAL SOCIETY.

ORDINARY MEETING HELD MAY 11TH, 1900.

Prof. O. J. LODGE, F.R.S., President in the Chair.

A DISCUSSION of Prof. LODGE'S paper "ON THE CONTROVERSY CONCERNING VOLTA'S CONTACT FORCE," was commenced by Prof. ARMSTRONG.

Prof. ARMSTRONG expressed his indebtedness to the President for putting forth clearly what we are trying to understand, and said that it was hardly time for chemists to enter the discussion when physicists themselves differed. There has apparently been a change in front since the effect was supposed to be due to (1) chemical action between metals or (2) oxidation. Prof. Lodge's view is intermediate, but approximates to the second. Prof. Armstrong said that from a practical point the existence of the effect was unknown because sufficient precautions had never been taken to prevent chemical action. He urged the continuance of experiments similar to those carried out by Mr. Spiers, and stated that modern ideas of chemistry were favourable to the view which Prof. Lodge had taken up with regard to the Volta effect.

Mr. GLAZEBROOK made some remarks upon the meaning of the term E, which occurs in the expression for the Peltier effect at the junction of two metals. If we confine our attention to an infinitesimal cycle at the junction of two metals at slightly different temperatures, we get the equation for the Peltier effect in which E is the potential difference at the point considered. If then, assuming reversibility, we sum up all the infinitesimal cycles round a circuit and get a finite cycle, the E.M.F. of the circuit is a function of the two temperatures between which it is working. Differentiating with respect to temperature the total E.M.F. of the circuit, we get an equation which applies to the circuit as a whole, and in which E is the total E.M.F. round the circuit.

Mr. PRICE asked if any critical experiment could be suggested to settle the question.

Dr. LEHFELDT called attention to some experiments which had been performed to measure the potential difference between an electrolyte and a gas. The electrolytes considered were chiefly aqueous solutions, and the potential differences observed varied largely. The surface tensions of the liquids were measured, and it was shown that the variations in the potential difference were very similar to those in surface tension. This suggests, in the case of electrolytes, true physical surface effects and not chemical action.

The CHAIRMAN remarked that Dr. Lehfeldt evidently looked upon the metal-ether boundary as being the effective one. The experimental evidence is not sufficient to say exactly which is the effective contact, but it seems to show that the metal-ether effect is of the same order of magnitude as the oxygen layer effect. According to Helmholtz they ought to be related, and they apparently are.

The CHAIRMAN then read a paper by Mr. J. B. TAYLER on "THE HEAT OF FORMATION OF ALLOYS."

Experiments have been made upon alloys of lead with tin, bismuth, and zinc, and of zinc with tin and mercury. The method employed consisted in dissolving (1) the alloy and (2) the corresponding mixture of metals in mercury, and measuring the heat of solution in each case. On the assumption that the solutions obtained are identical, the difference between the heat of solution of the mixture and that of the alloy is the heat of formation of the latter. The calorimeter was a thin glass tube silvered on the outside, and supported by a stouter tube silvered on the inside. Suitable arrangements were adopted for the introduction of the metals or alloys which were used in the form of filings. Solution was often complete in less than a minute, and rarely took more than two minutes and a half. The alloys first experimented upon contained their constituents in equivalent proportions, and the heats of formation were found to be small in comparison with those found for brass by Galt and Baker. It was thought that only a small percentage of the atoms present had entered into definite chemical combination, and that more reliable results would be obtained by dissolving a small quantity of one metal in an excess of the other, and calculating from the experimental results the heat of formation of the gramme-molecular weight of compound upon the supposition that the whole of the small quantity of metal had entered into chemical combination by the exercise of its normal valency. Using these numbers so obtained to find by Kelvin's theory the potential difference which should exist between the metals concerned when put in contact, results were arrived at which agreed neither with the Volta effect nor the Peltier effect, but which were considerably nearer the former than the latter.

Prof. S. P. THOMPSON then showed an "ELECTRO-MAGNETIC EXPERIMENT."

A circular coil capable of carrying a strong current was placed with its axis horizontal in a tank of water. Into the tank were also placed some small magnets in sealed glass tubes so adjusted as to have a density approximately equal to that of water. The magnets just floated or just sank. On running a current through the coil, it was possible to "fish" for the magnets, which acted upon by the magnetic field immediately made their way to the coil. When the current was carefully reversed upon the approach of a magnet, repulsion instead of attraction took place and the magnet retreated. In general, however, reversal of the current produced reversed polarity in the magnet and attraction still persisted.

The Society then adjourned until May 25th.

ORDINARY MEETING HELD MAY 25TH, 1900.

Prof. EVERETT, F.R.S., Vice-President in the Chair.

MR R. T. GLAZEBROOK then read some "NOTES ON THE MEASUREMENT OF SOME STANDARD RESISTANCES."

Three methods have been employed by the author for building up multiples of a standard resistance, such as a 1 ohm coil. The first method consists in making as accurately as possible three 3-ohm coils. These in parallel can be compared directly with the standard by Carey Foster's method. Their resistance in series is very approximately nine times that in parallel, and hence an accurate determination of a resistance about 9 ohms can be obtained. If then this resistance is put in series with the standard, an accurately known 10-ohm resistance is obtained. By a similar process a hundred or a thousand ohm coil can be built up. The second method consists in calibrating a resistance box. The 1 ohm coils of the box are compared directly with the standard, and the other resistances determined accurately by a building-up process, using a subsidiary resistance box. In comparing the high resistances the difference between the two boxes may be so great as to send the balance off the bridge wire. In these cases the third method is employed. The

equal arms of the bridge are accurately known, and one of them is shunted with a resistance, which need not be accurately known, until the reading is brought back into the wire. The coils chiefly used throughout the experiments are made of platinum-silver.

Mr. CAMPBELL asked if the same degree of accuracy could be obtained with manganin coils. If so, then the small temperature change of manganin would be an advantage.

Mr. TROTTER asked if proper allowance could be made for the large number of mercury cups used in Method 1.

Mr. RENNIE advocated the use of the build-up box in preference to the first method. With two mercury cups there is less chance of errors escaping notice than with eight. Every 10 or 100-ohm coil tested at the Board of Trade is subjected to a comparison with a box calibrated by a build-up process.

Dr. HARKER asked if the resistance of the eight mercury cups in series had ever been measured, and if so, what was the magnitude of the result, and what the uncertainty?

Mr. GLAZEBROOK said he had investigated the resistance of the mercury contacts, and it was negligible. In answer to Mr. Campbell, the author said he had no experience of manganin coils himself, but he had seen some figures for German coils which agreed very closely.

THE TOWNS' REFUSE PROBLEM.

THERE can be very little doubt that the economic disposal of the refuse in large towns and cities is very rapidly becoming a serious problem, the importance of which does not yet appear to be realised to its full extent by local and other authorities concerned, but perhaps this is scarcely to be wondered at, since the administration of matters closely allied with public health is often relegated to local bodies who, owing to the apathy of the educated classes, usually consist of men wholly incompetent to deal with the many important issues arising out of the government of any large area in which the density of the population is considerable.

What could be more appalling, more disgraceful in this age of so-called civilisation than the state of things to which "Incineratus" draws attention in the *Engineering Times* of last month. It is difficult to believe that at the end of the nineteenth century over 800 communities in England and Wales alone, with populations of 2,000 and upwards, still tip their refuse, and appear to be absolutely apathetic to the many dangers attending this method of removing waste matter.

It is almost incredible that this primitive method of refuse disposal is still in force in a town such as Portsmouth, for example. Here the amount of refuse available per day is something like 150 tons, but there is no destructor. "Incineratus" draws attention to yet another case in which there exists in close proximity to the limits of a large and important town, a heap of decomposing refuse, which is in so fearful a condition that its removal would be fraught with serious risk, not only to those concerned in its removal, but to the inhabitants of the town. In the *Dublin Daily Express* of March 28th will be found a long notice bearing on this. In many towns and villages, particularly those situated inland, where a similar state of affairs obtains, no one will ever be able to gauge, even approximately, the baneful influence that these heaps of putrefying animal and vegetable matter have had upon the health of the towns in question.

There is only one certain remedy for this, namely, to burn all refuse, whatever its nature, irrespective of expert opinion as to the degree of its innocuousness. But let us be honest about it and be prepared to pay for the advantage gained by the burning of the refuse without reference to any economy which may be attainable in the shape of power from steam generated by the heat of combustion of the refuse. It is certain that the slow progress which has been made in the introduction of refuse destructors—or to adopt a more euphonious name, incinerators—is in a large measure due to the wild and extravagant claims made by individuals pecuniarily interested in one or other of the types of incinerator, as to the amount of water that can be evaporated from a pound of "average" refuse by the adoption of one particular type of furnace—of course, to the exclusion of all others. Although it would be foolish not to take advantage of any and every means of reducing the burden upon the ratepayers of administering the affairs of any town or district, we have consistently upheld the doctrine that no pecuniary consideration of any kind should be allowed to weigh in the balance when deciding upon the best method, hygienically, of disposing of the refuse of a town; and, generally speaking, the worse the refuse is from a steam raising point of view, the more urgent is the necessity for its destruction by burning. The system of barging out to sea is at the best but an apology for a better system, and never to be recommended on any ground except that of comparatively small cost, which, as we have said before, should not be allowed to influence the selection of a system of refuse disposal which is not hygienically efficient.

Owing to the extreme variations in the character and quality of refuse (sometimes from hour to hour throughout the day) it is a perfectly hopeless fuel for any purposes requiring a steady steam pressure. Mr. Ed. C. de Segundo has shown, in an article which recently appeared in this journal, how powerfully the percentage of moisture reacts upon the calorific power of refuse when considered as a fuel. At a comparatively low percentage of moisture—for town refuse—the proportion of the remaining combustible necessary to evaporate the moisture would render the refuse valueless from the point of view of steam raising. The complete absence of anything approaching reliable and impartial records of the performance of incinerators over sufficiently long periods renders it quite impossible to form any opinion as to the real value of refuse as a fuel, and we very much doubt whether any of the results of steam raising put forward by those interested in incinerators would be borne out by the average results of one year's working under ordinary everyday conditions.

In a paper recently read before the Society of Engineers by Mr. B. D. Healey, it is stated that "it is found that 1·26 lbs. of water can be vaporised by 1 lb. of average unscreened refuse * when burnt in well-constructed furnaces and assisted by a forced draught at a pressure of 1·25 inch water gauge."

When dealing with the all-important question of moisture, Mr. Healey says "the moisture in town refuse varies from 15 per cent. to 47 per cent. organic, and animal matter having from 70 per cent. to 80 per cent. moisture, and refuse mixed with sewage sludge about 70 per cent. moisture. The clinker varies from 19 per cent. to 42 per cent."

We shall not be running any serious risk of contradiction in assuming, for the purposes of calculation, that "average" refuse to which the steam-raising power above mentioned is credited, will contain 30 per cent. moisture and 30 per cent. clinker, leaving 40 per cent. of combustible, of which 35 per cent. may be taken to be carbonaceous matter and 5 per cent. other combustible matter. The temperature of the gases at the base of the chimney may be taken roughly at 500° F. from the results quoted by Mr. Healey in the table appended to his paper. It will not be out of the way to take 5 lbs. of air as passing through the furnace for every pound of refuse burnt, and to assume that 10 per cent. of the steam raised is used for producing the forced draught (at Shoreditch it is nearer 14 per cent).

Following Mr. de Segundo's method, we then arrive at the calorific power of the combustible part of the refuse as follows:—

	Th U.
1·26 lbs. of water evaporated from and at 212° F. contains nearly	1,386
The heat carried away in the issuing gases would be $5 \times 0{\cdot}23 \times 500 =$	575
The heat necessary for evaporating the moisture in the refuse is $0{\cdot}30 \times 1{,}100 =$	330
The heat absorbed in raising 0·30 lb. of the material to the temperature of the furnace = say	180
Total	2,471

to which should be added at least 5 per cent. for radiation losses, bringing the total up to 2,594, say 2,600 thermal units.

As this has to be obtained from the combustion of 0·40 lb. of combustible, the calorific value of this portion of the refuse must be

$$2{,}600 \times \frac{100}{40} = 6{,}500 \text{ thermal units per pound.}$$

This refuse, therefore, possesses a constituent which has a calorific value equal to about one-half that of good coal. The question arises, where does it come from?

The following list gives the constituents of London refuse

* Presumably from and at 212° F., but the author does not say how.

as set forth in Colonel Codrington's report in 1888 to the Local Government Board on the subject of refuse destruction :—

	Per cent.
Ashes	52·6
Breeze (cinders)	28·8
Soft core (animal and vegetable refuse)	14·2
Hard core (broken pottery, &c.)	2·9
Coal	0·15
Bones	0·25
Rags	0·425
Old iron	0·35
Old metals	0·025
White glass	0·075
Black glass	0·225
	100·000

Colonel Codrington gives the average composition of Manchester refuse as follows :—

	Per cent.
Ashes and excreta in pails	64·5
Dust and cinders	34·55
Fish and bones	0·15
Dogs, cats, hens, rabbits, &c.	0·05
Boots, rags, hats, paper, &c.	0·05
Vegetable refuse	0·05
Glass, pottery, bricks, &c.	0·60
Old iron and tin ware	0·05

These records are sufficient to indicate the varied composition of refuse, and when considering the possible value of refuse for raising steam for any purpose requiring a steady pressure, it must be borne in mind that this class of refuse is not the only one that has to be dealt with in a large town. For instance, during one year at Leeds the following articles were dealt with in addition to the usual ashbin refuse :—11 cows, 3 calves, 17 sheep, 4 goats, 298 pigs, 5 turkeys, 2 carcases of beef, 28 quarters of beef, 9 cwt. of pork, 10 cwt. of pickled tongues, 12 cwt. of herrings, 218 cwt. of shell fish, 1 cwt. of sugar, 285 dogs, 109 cats, 13 foxes, 1 sea serpent, 147 mattresses, beds, pillows and bolsters, 7 blankets, 36 pieces of carpet, 7 hearth rugs.

This is not an unusual year's list, and at times of an outbreak of epidemic such as swine fever, the proportion of animal matter is largely increased.

(*To be continued.*)

CURRENT SPECIFICATIONS.

XIII.—BRIDGWATER ELECTRIC LIGHTING.

SUMMARY.

Scope of Tender.—Complete equipment for electric lighting scheme, divided into seven sections, viz., (*a*) boiler house plant, (*b*) engine house plant, (*c*) switchboard, (*d*) underground mains and public lighting, (*e*) meters, (*f*) accumulators, (*g*) crane.

System of Lighting.—Direct current three-wire system, using accumulators and balancers, the voltage at generating station between the middle and either of the outer conductors being 250 volts.

Type and Size of Boilers.—Two to be supplied either of straight water-tube or "Economic" type, each to evaporate 4,000 lbs. of water per hour, at 160 lbs. square inch pressure, and to be fitted with superheater. Alternative offers to be made for larger boilers, each to evaporate 5,000 lbs. of water per hour.

Type of Generating Plant.—Two sets to be supplied, engine to be of high speed compound type (if direct acting having all working parts covered in), direct coupled to continuous current dynamos.

Speed Specified.—Not to exceed 450 revolutions per minute.

Output of Engines.—Each to easily drive at full load when working non-condensing with 135 lbs. square inch steam pressure, a 90-KW dynamo.

Output of Dynamos.—Each to develop 90 KW. at 500 volts when run at speed not exceeding 450 revolutions per minute.

Alternative Offers.—Alternative offers to be made for two 100-KW. steam dynamos of similar type, and also two sets each to develop 125 KW.

Output of Balancer.—To have a double-wound armature designed to deal with an out-of-balance current on either side of three wire system.

Output of Boosters.—Two to be supplied each capable of raising voltage 110 volts, wound for a current of 40 amperes. Both boosters to be driven by one motor.

Switchboard.—To be suitable for a three-wire direct-current station, having provision for dynamo, accumulator, feeder, and public lighting panels.

Specified Insulation for Cables.—Specially prepared paper, or other approved material, lead-covered and steel armoured. A guarantee for seven years to be given with tender.

Number of Arc Lamps.—Eighteen to be supplied of Crompton-Pochin, Brockie-Pell or other approved type, 12-ampere size.

Capacity of Cells.—At nine-hour discharge rate, not less than 360 ampere-hours with final terminal voltage of 500 volts. Emergency discharge, 200 amperes for one hour.

Capacity of Crane.—To lift 5 tons and be suitable for a span of 33 feet.

Specified Date of Completion.—Crane in four months from date of order, underground mains, public lighting and meter in five months, rest of plant in six months.

Penalty for Late Completion.—*One per cent.* of gross contract sum due to each contractor per week.

Terms of payment.—80 per cent. as work proceeds; 10 per cent. on completion; 10 per cent. at end of 12 months.

Stipulations as to Wages paid to Workmen.—None.

Stipulation as to Removal of Foreman.—Satisfactory.

Arbitration.—Unsatisfactory. (See below.)

Date for receipt of Tenders.—June 7th, 1900.

This specification has been prepared by Mr. W. H. Trentham, and in many respects is similar to the Rhyl specification, commented upon in our issue of the 4th ult. It will be noticed that an unusual amount of work is thrown upon tenderers, offers being asked for two sizes of boilers and three sizes of steam dynamos. It is also stipulated that all foundations for the steam dynamos, boiler seatings and flues are to be included in the offers for the different sections.

The steam dynamos are to be submitted to the usual six-hour full load test after erection, fuel and water being provided free by the purchasers. The combined efficiency of the sets must not be less than 84 per cent., and the temperature rise of any accessible part of winding measured thermometrically not more than 65° F. No definite steam consumption guarantees are asked for, though doubtless high-class plant is demanded.

Offers are invited for all or any of the sections, tenderers being invited to state by how much they would reduce the price for separate sections on condition that he obtained the contract for two or more sections. It would be well to bear in mind that the penalty for late completion is calculated on the total contract placed with each contractor, so that in the event of one item being late, the contractor for two or more sections is in a far worse position as regards penalty than the contractor for only one section, though the loss to the Corporation is the same in each case.

We think that in every contract where it is open for tenderers to send in offers for separate sections of the work, the penalty to be enforced in the event of late completion should be the same sum whether the contract for part or the whole of the work is placed in the hands of one contractor.

The clause relating to this, as at present worded, reads :—

> Should the contractor fail to complete the works by the date herein stated or by such date or dates as may be substituted by the engineer, he shall be liable to pay to the Council, as and for agreed liquidated damages, £1 *per centum of the gross sum payable to him under his contract for each and every week which may have elapsed between the appointed time and the actual time of completion* hereinbefore mentioned and provided for, and the Council shall be entitled to deduct these damages from any moneys in its hands due, or to become due, to the contractor hereunder.

We advise that exception be taken to the following clause, which is palpably unreasonable :—

> *All works to be carried out under the direction, control, and to the entire satisfaction of the engineer in every respect;* but the contractor shall set out the work at his own expense and be responsible generally for the same, and *no plea or claim as to the acts, order, or general supervision of the engineer will be admitted in justification of any error of construction or fixing.*

It is first stipulated that *all works are to be carried out under the control of the engineer*, and then, as clearly stated, that he is to be in no way responsible for any mistakes he may make. This separation of *control* and *responsibility* is opposed to the fundamental principles which govern the relationships of successful commercial life. The engineer ought to either permit the control to be in the hands of the responsible contractor, or else be willing to take the responsibility of his own acts.

The arbitration clause is unsatisfactory. It reads :—

> If any dispute or difference (*exclusive of all questions within the powers of, or which are to be, determined by the engineer*) arise under this contract between the Council and the contractor upon any matter whatever, such dispute or difference shall be referred to an arbitrator,

and this contract shall for such purpose be a submission under the "Arbitration Act, 1889."

And excludes from any decision by an impartial authority such questions as the following :—

Should there be any doubt or obscurity as to the meaning of any portion of the specification, plans, or general conditions, firms tendering must set forth the particulars thereof and submit the same to the engineer, in order that any such doubt or obscurity may be removed before the acceptance of the contract. *If any such misunderstanding should arise during the progress of the works, the decision of the engineer as to the meaning of any dimension, clause, word, sentence, or otherwise must be taken as final.*

This contract to include all such works as are usual or necessary for the completion of the several works, and also all works that may be fairly implied from the drawings or specification, although the same may not be specifically mentioned; and where the manner of performing any portion of the works so included or implied shall have been omitted to be described, the same shall be executed in a sound and perfect manner corresponding with the other works.

And :—

The contractor shall not alter in any way whatsoever any of the work except as directed by the engineer, but the engineer shall have full power to alter, amend, omit, or otherwise vary any of the works without in any way affecting or vitiating the contract, and the contractor shall carry out such alterations, amendments, omissions, or variations, and be bound by the same conditions as though the said alterations, amendments, omissions, or variations occurred in the original specification and contract. *The difference of cost occasioned by such variation shall be ascertained* in accordance with the schedule of prices, or where such schedule does not apply *the engineer shall determine the amount of such additions or deductions*, and add to or deduct from the contract price accordingly, and *his decision shall be accepted by the contractor as final.*

We feel sure that few of our readers have realised the extent to which attempts are being constantly made to limit and nullify the operation of arbitration clauses in public contracts. It must have been noticed how in these weekly comments, by far the most frequent cause of complaint has been interference with the free operation of an appeal to arbitration. We hope that consulting engineers will follow the example set by some of the most eminent members of their branch of the profession, and refuse to subscribe to general conditions which place them in the undignified position of acting as counsel and judge of their own case.

XIV.—DUNDEE CITY TRAMWAYS.

Summary.

Scope of Tender.—Equipment on overhead system of 3·8 miles of tramways.

Character of System.—Double trolley line throughout, suspended over centre of track.

Specified Dates of Completion.—

Section	1A.	1,286	yards of route in	8	weeks.
"	2A.	374	" "	4	"
"	3.	1,923	" "	12	"
"	4.	2,732	" "	10	"
"	5.	376	" "	4	"

Penalty for Late Completion.—*Twenty pounds* per section per week or part of a week

Stipulations as to Wages Paid to Workmen.—Standard rates to be paid—see below.

Stipulations as to Removal of Foreman.—Satisfactory.

Terms of Payment.—Up to 90 per cent. as work proceeds, in monthly payment, 5 per cent. on completion, 5 per cent. at end of 12 months' maintenance.

Arbitration.—Satisfactory.

Mr. W. H. Tittensor, the city electrical engineer, is responsible for the preparation of this specification, and we may congratulate him on the manner in which he has carried out his task.

The apparatus required is clearly scheduled, separate tenders are asked for the different sections, detailed prices being given in each case, and a schedule of rates at the end of the tender, to be used for adjusting prices should the quantities actually required vary from the numbers given.

With the exception of six centre poles, side poles with brackets of varying lengths are specified, double insulation is to be used in all cases, and the material employed is to be approved by the engineer.

The permissible dates of completion are very short, and can only be met if the contractor is sure of unusually prompt delivery of the poles.

The general conditions are, on the whole, of a satisfactory nature, there being no contradiction in terms between the clauses dealing with arbitration and the engineer's power to reject work during the course of the contract.

As an example of what we consider to be suitable clauses to protect the interests of both parties, we reprint both paragraphs.

Clause 12 referring to the engineer's power to reject work, states :—

If the contractor shall so desire, and of such desire shall give notice in writing to the employers within 72 hours after receiving notice from the electrical engineer, the question involved by any such decision of the electrical engineer may be submitted to arbitration, as herein provided. But declaring that during the progress of the works the electrical engineer shall be sole judge (under reservation of the rights of both parties), and that his decisions shall be obeyed until the contract is completed.

The contractors shall not, under any circumstances, cease to proceed with the execution of the contract to the prejudice of the employers.

while Clause 30 is practically in the standard terms agreed upon between the Electrical Plant Manufacturers' Association and the Municipal Electrical Association.

In case any dispute or difference may arise between the employers, or the engineers on their behalf, and the contractors, either during the progress of the works, or after the determination, abandonment or breach of the contract, as to the construction of the contract, or as to the reasonableness of any extra charge, or as to the withholding by the electrical engineer of any certificate to which the contractor may claim to be entitled, then either party may within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration.

The only other clause calling for special mention is one forbidding the employment of any person under 20 years of age on the works. This is a matter which we feel can well be left to the discretion of the contractor, who is responsible for the satisfactory completion of the contract.

As the work of erection is to a large extent of a special character, it is unlikely that others beside the contractor will be carrying it on at the same time in the district, so that his rates will necessarily be standard for the time being. The clause in question reads :—

The contractors shall be bound to pay the workmen employed by them not less than the standard rate of wages relating to the particular class of work to which this specification applies which may be in force during the period that the work is being carried out.

No person under the age of 20 years shall be employed on the works.

HIGH EFFICIENCY LAMPS FOR ISOLATED INSTALLATION.

By JAMES WHITCHER.

When the expiration of the incandescent lamp patents reduced the cost of lamps at a bound to about a third of their arbitrary price under the monopoly, there appeared in the electrical trade and profession an almost universal disposition to boom the use of high efficiency lamps. The *pros* and *cons* of the great lamp controversy "High efficiency and short life *versus* Low efficiency and long life," were most exhaustively and variously discussed; and what seemed practically a convincing weight of argument was adduced in favour of high efficiency. Yet to-day we find that the boom has failed to materialise in anything like a general way; and, in spite of the fact that the arguments for the contrary course (because of the continued cheapening and improvement of the lamp) are stronger now than ever they were, the standard practice is, against all reasons, dropping helplessly and hopelessly back upon the old rule of at least 4-watt power consumption per candle-power of light.

The light-hearted casuist might argue that we must be only following the teachings of experience in thus reverting to the old way, which after all must be the right way; and that the new way must have been built on unstable foundations which could not withstand the full tide of trial. His deductions, however, would fail of intelligence, for without doubt the real cause of the retrogression is the perversity of the non-technical consumer, or rather user, of the electric light. This one can and does appreciate very rapidly and forcibly the failure of a lamp; but he has seldom the patience or the means of studying the differences in current consumption. He will pay, with less suspicion and com-

plaint, a pound extra for current, than a shilling extra for lamp renewals. Suppliers of lamps realise this very soon, finding that to recommend and supply high efficiency lamps is, under the circumstances, to risk the loss of a customer. If such a one persists, and takes up the thankless task of educating his client up to the better practice, it is more than likely that a less scrupulous competitor will step in in some unguarded moment, and so confuse his client's mind by the apparent conflict of technical advice, that he makes a weary resolve only to look after the lamp consumption which he *can* understand, and to leave the power consumption, which he *cannot* understand, to look after itself.

This, then, is the potent influence that makes for the non-success of the movement; but it is scarcely right for electrical engineers to give way to it in the nonchalant manner they are doing. It may be that the attention of most is diverted from the point by the introduction of high voltage lamps in connection with which the high efficiency class is practically non-existent up to the present; and the subject will come up for consideration again. However, in the meantime there is much danger of an inefficient and undesirable practice becoming crystallised and hard set, and very difficult to break through hereafter. The object of this article is to recall once more some of the arguments for high efficiency lamps, and to show again how powerful these are.

To arrest attention, if nothing more, let us plunge at once, *in medias res*, and take up what is, perhaps, the strongest case of all in point; *i.e.*, of a private supply of electric lighting through a battery of accumulators. Examination of a practical instance suffices to show that considerations relating to the battery alone exhibit a considerable balance of advantages in favour of the "short-and-merry-life" lamp. We will take for our example an installation in a private house, say a country residence, requiring 100 16-C.P. lamps or the equivalent. A good rule for the size of generating plant for such a purpose, is to make it just large enough to supply the full number of lamps direct at reduced voltage or speed; and the battery should be capable of supplying the whole output for about seven hours. This battery could be fully charged at a good economical rate by the generating plant running for about eight hours at full power. In the depth of winter a full charge of eight hours' duration every other day, or a four hours' charge every morning, would more than meet the probable lighting requirements. To put in larger plant and battery would be unduly to burden the undertaking; to put in smaller would not leave a satisfactory margin for emergency on occasions of extra lighting, as balls and so forth.

Below we tabulate sizes and costs of batteries for lamps of 4, 3½, 3, 2½ and 2 watts per candle-power, and the estimated annual cost of maintenance of same in a thoroughly efficient and satisfactory working condition.

TABLE I.

Costs of battery of 54 cells for 100 volts E.M.F. to feed 100 16-C.P. lamps of various wattages per candle-power for 7 hours, with a final fall of voltage to 1·85 volts per cell.

Column 1.—Wattage of lamps per candle-power.

Column 2.—Total output of current to lamps; also best charging rate, and allowable rate of discharge for duration of seven hours. Duration of charge after such period of discharge to be eight hours.

Column 3.—Number of positive plates in battery.

Column 4.—Cost of battery complete of typical high-class manufacture, with glass cells, plates, and connections, trays, insulators, spray arresters, and stands, with an allowance of 10 per cent. for cost of erection and connection.

Column 5.—Annual capital charges for interest at 2½ per cent., and maintenance repairs and renewals of battery, to keep same in thoroughly efficient working condition, at 10 per cent.

Col. 1. Watts per C.P.	2. Amperes.	3. + Plates.	4. Cost.	5. Capital charges.
4	64	8	£280	£28
3½	56	7	250	25
3	48	6	220	22
2½	40	5	190	19
2	32	4	160	16

These costs are estimated on the high rates now current, amounting practically to a 15 per cent. advance on prices quoted before the rise. The maintenance rate at 10 per cent. is a perfectly fair one, including, as it does, interest on investment and all risks. Lower rates have been recorded, even as low as 4½ per cent., excluding interest, but with batteries much larger in comparison for the work done, so that the actual expenditure remains practically the same.

Now the average lamp hours for the installation will be about 700 hours per annum each lamp; that is the average for the 100 lamps; some, of course, being in duty much longer time, others much less. And this time we may take as a fair limit of the endurance of the 4-watt lamp. Therefore, at 1s. per lamp, the annual lamp renewal bill will be £5. Comparing this with the differences in the maintenance costs for the batteries, we see that the saving in these charges by using 3-watt, as compared with 4-watt lamps, is sufficient to cover 120 per cent. extra lamp renewals per year, and in the case of 2-watt *versus* 4-watt lamps, we may have 240 per cent. extra lamp renewals per year, and still balance our accounts. In other words, if the endurance of the 4-watt lamp average 700 hours, that of the 3-watt lamp 300 hours, and that of the 2-watt 200 hours, there is an equality between the cost and advantages of each, taking this consideration of the battery alone into account. Now there is certainly not so wide a disparity in the endurance of the 4 and 3-watt lamps; so that quite apart from the reduced capital charges on the other items of the plant, and the lower working costs, there is a clear advantage for the 3-watt lamp. The life of 2 and 2½-watt lamps of small candle-power is uncertain, so that we must put their case aside for the present.

To follow out the question to its fullest extent, we will now take into consideration the other details of the plant and the working costs. In Table II. we tabulate the capital investments necessary for the various items of plant other than battery, which we have given, and wiring, the cost of which would not be affected more than about 2 per cent. by the difference in cost of wire for the maximum difference in lamp wattage. The prices are assumed for an oil engine installation carried out in good higher-class style and liberally dealt with so as to secure a thoroughly reliable and economical plant, easy to attend to and keep in first-class working order.

TABLE II.

Costs of engine houses and plants and mains for supplying 100 100-volt 16-C.P. lamps of various wattages, in conjunction with batteries in Table I.

Column 1.—Wattage of lamps per candle-power.

Column 2.—Area in square feet of engine and cell houses.

Column 3.—Size of oil engine in B.H.P.

Column 4.—Size of dynamo in kilowatts at 140 volts.

Column 5.—Cost of buildings complete at 10s. per square foot.

Column 6.—Cost of engine including tank, piping, and all accessories, and belt, erected.

Column 7.—Cost of dynamo with slides and shunt regulator, erected.

Column 8.—Cost of switchboard and instruments (£25). Connections and mains to house, say 50 yards run.

Watts per C.P.	Buildings, sq. ft.	Engine B.H.P.	Dynamo KW.	Cost of buildings.	Cost of engine.	Cost of dynamo.	Cost of switchboard, &c.	Total costs.
4	520	16	9	£260	£255	£89	£50	£654
3½	450	14	9	230	240	89	48	607
3	420	12	7	210	235	80	45	570
2½	380	10	5·5	190	190	71	42	493
2	350	8	4·5	175	175	58	40	448

The building area is calculated to allow the cells being laid in a double row on low single-tier stands with a gangway each side—which the writer considers the best arrangement for enabling a thoroughly efficient watch to be kept over them. The engine power is made ample, because nothing is more productive of extraordinary troubles and expenses than gas or oil engines run past their limits of output, unless the attendance is of high-skilled order. The dynamos have three bearings and extra heavy fly-wheels.

A fair rate for the capital charges on the above is 5 per cent., being 2½ per cent. interest on investment and 1 per cent. maintenance on one-half the amount, and 4 per cent. on the remainder. This is the assumption on which we have based the amounts given in Table III. below.

In judging of the working costs, we have practically only to consider the consumption of petroleum and lubricating oil. These plants are usually attended to by the gardener, or some handy man about the estate; and although the smaller plant naturally makes less demands upon his time, it is not possible to evaluate the difference. For the small engine, we will take the oil consumption at the rate of 1 pint per B.H.P., varying down to ¾ pint per B.H.P. in the largest engine. The total hours of running per annum will be 800; the price is now about 7d. per gallon. Therefore, with a 10 per cent. allowance for waste, and 10 per cent. for lubrication and sundry stores, the running charges will work out at about the figures given in Table III., which we now give:—

TABLE III.

Column 1.—Wattage of lamps and estimated life.
Column 2.—Capacity of plant required in kilowatts, net.
Column 3.—Capital charges on generating plant at 5 per cent.
Column 4.—Capital charges on battery.
Column 5.—Sinking fund and insurance at 2½ per cent.
Column 6.—Lamp renewals at 1s. per lamp estimated on the arbitrary values given for the endurance in column 1.
Column 7.—Working costs per annum.
Column 8.—Total gross cost per annum.

1 Watts.	Hrs.	2 Kilo-watts.	3 Gene-ration.	4 Battery.	5 Sinking.	6 Lamps.	7 Work-ing.	8 Total.
4	700	9	£33 10	£28 10	£23 10	£5 0	£42	£131 10
3½	500	8	30 10	25 0	21 10	7 0	39	123 0
3	300	6·75	28 10	22 0	19 10	12 0	36	118 0
2½	200	5·6	25 0	19 0	17 0	17 10	32	110 10
2	100	4·5	22 10	16 0	15 10	35 0	25	114 0

The propriety of charging interest and sinking fund in such a comparison may be questioned. We would point out, however, that the money if not spent would, otherwise invested, bring in at least the sum charged for interest; and as it is sunk in on investment which is liable to amortisation, and is, moreover, unnegotiable except in a restricted sense, the sinking fund and insurance charge is also legitimate.

The above capital and working costs will appear high, perhaps, to the engineering contractor and those who make a business of supplying electrical energy. But it must be remembered we have to look at the question from the buyer's point of view, and take into consideration the gross and final costs to him. He is by no means making a speculation of it, but is simply acquiring a luxury, and he is able and willing to pay for the uninterrupted enjoyment of that luxury, looking less at the call upon his finances, than at the possible bother of it all. Where he hesitates most is at making any initial outlay at all upon the luxury; and here in itself is sufficient justification for a high efficiency lamp scheme in contradistinction to a low efficiency scheme. The very heavy capital expenditure entailed is the most potent and active deterrent to the introduction of electric lighting in such cases, and any proposal which reduces it, even at the cost of extra annual charges, has a special influence in the decision whether it is to be or not to be. We have by design made our instance what may be described as a very busy country residence: one housing a large and socially inclined family and having, so to speak, no close time. This, of course, is all against the argument we are using the instance to point.

The figures given in Table III., which are purposely chosen to err on the side of the low efficiency lamp, show that a very large increase in the lamp renewal bill must result before the economical advantages, arising in all other respects out of the application of high efficiency lamps, become annulled. Indeed, in face of all the facts and figures of the question, which are decidedly not new or unknown, it is difficult to see how electrical engineers can conscientiously continue to advise or specify the old-time standard of 60-watt lamps for isolated lighting schemes. Nowadays the highest limit for the same should be 50 watts per 16-C.P.; and where lamps are fed only through accumulators there is strong justification for going as low as 40 watts per 16 C.P. In fact, the application of high efficiency lamps ought to be recognised and utilised as one of the greatest concomitant advantages of a storage system.

The writer's excuse for the above article is the great danger at present evident of the decisive economic principles which govern this question becoming entirely obscured. To show how lost to sight they are apparently getting, here is a case in point. A contractor contracted for and carried out a small installation something on the lines indicated above with 3-watt per candle-power as the lamp basis. A consulting engineer reporting on it practically condemned the scheme; and the contractor, in order to secure an amicable settlement, had to submit to entirely unmerited loss and suspicion. The contractor's scheme was honestly and intelligently conceived on thoroughly sound principles, and as Table III. shows in the best financial interests of his client. Yet in these enlightened days he is perforce immolated on the altar of a mere tradition, that antiquated byeword in the profession, "the 60-watt lamp."

REVIEWS.

Problèmes sur l'Electricité; recueil gradué comprenant toutes les parties de la science électrique. Par ROBERT WEBER, docteur ès sciences, professeur de physique a l'université de Neuchatel. Troisième edition. Paris: Ch. Béranger. 1900.

Collections of scientific and mathematical problems are exceedingly useful to all teachers and students, and this particular collection should be no exception to the rule. It contains 746 problems, all of an elementary kind, and requiring as a rule only the application of arithmetic to the laws they illustrate. They are varied, and in many cases suggestive.

Dizionario tecnico e nautico di marina. Italiano, Tedesco, Francesco, ed Inglese. Supplemento del primo volume.
Nautisch-technisches wörterbuch der marine. Deutch, Italienish, Französisch, und Englisch. Ergänzung zum ersten bande.
Verlag der redaktion der "Mittheilungen aus dem gebiete des seewesens." Pola. 1900.

This supplement to an existing dictionary of marine technical terms contains striking evidence of the development of applied science within the last 20 years. It contains 858 octavo pages, and has itself an appendix of 10 further pages. It has evidently been constructed with great care.

Annuaire pour l'an 1900, publié par le bureau des longitudes, avec des notices scientifiques. Paris: Gauthiers-Villars.

A paper-bound pocket-book giving the principal astronomical data for 1900, money data, tables of interest and annuities, of geography and statistics, of magnetic elements, and of physical and chemical constants. The scientific notices are by M. Cornu on electrical generators, by M. Lippmann on the new atmospheric gases, and by M. Janssen on the Mont Blanc Observatory and the use of æronautics in astronomical observation. It should be exceedingly useful, and the price is certainly very low.

Mésure des grandeurs électriques dans les circuits alternatifs. Par OMER DE BAST. Liége: Léon de Thier. 1899.
Mésures électriques. E. VIGNERON and P. LETHEULE. Paris: Gauthiers-Villars; Masson et Cie.

These are little more than pamphlets, giving in a condensed form clearly and succinctly the principal information on their subjects. The second of the two is one of a series

of such books published under the direction of M. Léauté, member of the Institute, termed "Encyclopédie scientifique des aide-mémoire."

Steam Engine Theory and Practice. By William Ripper. London: Longmans, Green & Co. 1899. 9s.

This is less an original work than a well-digested compilation of recent writings, but at the same time it may be said to come somewhat within the range of books not required, not because in itself it is not a good book, but because it deals with so well worn a subject. The unfortunate parents of the technical scholar who a year ago spent money to provide college text-books for son No. 1, may be pardoned if they feel somewhat impatient that son No. 2 will be wholly out in the cold unless provided with an entirely new set of volumes. The advances in physics and chemistry in steam and other heat engines, and even in electricity, are not so rapid that school text-books should become obsolete before their gloss is worn off by the average careless and destructive youth. The fact is that every newly-fledged professor appears to think it incumbent on himself to write a book, and the present author is only less blameworthy than many of his *confrères* in that he has produced one better than usual—a common sense sort of book on the whole, in which we fail to find that pet word of the hide-bound professor—to wit, poundal. On the whole the book is fairly clear—a little too mathematical, perhaps, where plain statement would have served as well. It seems a pity when simple matters are so confused under a mathematical verbiage that more exact statements of fact are not made.

In discussing the specific heat of gases, it is practically overlooked that this varies with the temperature, and the ratio of the specific heat at constant pressure to that at constant volume is given as though both had a definite value for all temperatures, though it is perfectly well known that the two values are not to be correctly compared by a ratio so much as by a fixed difference. Properly speaking it is a misnomer to speak of the specific heat at constant pressure, as this is really a compound value made up partly of internal work in the gas, and external work performed against the atmosphere. There are chapters on high-speed engines and on design, which have the merit both in the matter of stationary and locomotive engines of being illustrated by sufficiently modern examples, and an appendix contains a brief description of the author's mean-pressure instrument. When dealing with single-acting engines the author appears alive to the fact that these are at a disadvantage in having their crankshafts exposed to such extraordinarily severe reversals of stress in its body and crank pin.

The entropy chart of Capt. H. R. Sankey is reproduced as a frontispiece, and Prof. Boulvin's method of transferring indicator diagrams to the entropy chart is clearly illustrated and the method described sufficiently for the student to take up this system of investigation. The chapter on balancing is not very clear, especially the reference to Mr. Ranson's four-cylinder locomotive, which directly and erroneously contradicts what the author has previously advanced as to the impossibility of balancing two revolving masses which revolve in different vertical planes, unless a third mass in a third plane be introduced. Professors never seem to dare to step outside the beaten path of old practice, or we might find some of the body daring to suggest the abolition of the crank angle of 90° in favour of the 180° angle, which would permit, except for the angularity of connecting rods, an absolute balance in a three or a four-cylinder engine for, say, express work. Stationary engines of far less power run with single cranks only, on very much less fly-wheel energy than that possessed by a modern heavy express engine, and the barring engine is altogether too familiar in practice for locomotive men to be ignorant of its utility. It seems a pity that no author-professor ever feels sure enough of his ground to be able to advocate anything from the beaten path, or to apply his brains, trained in mechanical gymnastics, to show the practical world how much it might accomplish, if only it would have faith in the laws of mechanics. Only a few days ago we heard a Scotch engineer say of a novel but perfectly rational suggestion, "Man, I never saw sic a thing done before, and I canna see how it will dae,"—an ulta cautiousness that our merely practical men possess that prevents them from daring any new step, because they are too ignorant of scientific possibilities—a fault, by the way, that is less pronounced in the educated Germans who, in many ways, are realising possibilities which our own countrymen are passing by in ignorance. And in all the struggle against this kind of thing we should like the engineering professors of the country to show a little more pluck and originality and less "heaving of poundals and other fossils," and quarrelling over useless definitions.

Spon's Architects' and Builders' Price Book, 1900. By W. Young. London: E. & F. N. Spon, Limited.

This well-known handbook, which has now reached its 27th edition, contains a mass of useful data relating to masonry and brickwork, iron, wood and concrete constructions, gas and water appliances and fitting, &c., with standard prices for the materials and labour employed therein. Electric lighting and lightning conductors are dealt with in a section comprising 25 pages, which is, however, in some parts out of date. For instance, the cost of a 200-light installation in a country house is placed at £1,250, fully one-third above the cost to *the buyer*, let alone the actual cost to the contractor. Again, glow lamps are quoted in one place at 4s. each; Rules and Regulations issued by "The Society of Telegraph Engineers and Electricians" (*sic*) as long ago as 1888, are inserted; the capital and running costs are given of an installation in a London Bank, which is *said* to have been at work for about two years, but seeing that the lamps are here quoted at 3s. 9s. each, this seems doubtful. A footnote to the last example corrects the price of lamps to 1s. 9s., and modern lists of prices of lamps, switches, and fittings, are given; wood casing is also listed, but steel conduits and lead-covered wire are conspicuous by their absence.

ELECTRIC TRACTION ON THE "UNDERGROUND" RAILWAY.

An esteemed contemporary last week, in a captious and peevish leading article, took to task the directors of the Metropolitan and District Railways on the occasion of the opening for public traffic of the electric section between Earl's Court and High Street. According to the writer the experiment is 10 years belated, is quite unnecessary, and is on wrong lines.

It would have added much to the clearness and force of the demonstration if the latter part of the article had not obviously forgotten the beginning, and if the whole were not flatly contradicted by the statement, in another part of the same issue, of the purposes for which this experiment was undertaken, which do not happen to be the supposed purposes ridiculed in the article.

In the first paragraph we find "Everyone is asking, why was not this thing done five or ten years ago?" In the last it is stated "Neither can it be claimed that the particular type of train or system of track-work are such as the engineers would recommend for a permanent equipment of the Underground Railway system. Indeed, it appears to be certain already that, in the event of such extensions, quite different arrangements would be made. In the Inner Circle, for example, it would be far better to place the working conductor or conductors near to the top of the tunnel where there would be less risk of their giving shocks to platelayers or becoming earthed by being accidentally connected to the track rails by means of, say, a crowbar."

Whence it appears that what, in the opinion of the writer, could have been done any time this ten years, has now been so badly done by the men chosen to carry it out that the first casual critic can detect the errors committed. This, if it were true, would be a good argument for deferring the work another ten years. Again, in the description accompanying the illustrations of the work, as done, we find the following statement as to the object of this experiment:—"It required, of course, no experiment to prove that electricity was capable of running satisfactorily and safely trains similar to those on

the Underground Railway, and on quite as rapid and frequent a service. It was unnecessary to spend £20,000 to prove this. But the boards of the associated railway companies needed tangible proof that their railway system could be converted from steam to electric traction without the least interference during the process with their ordinary steam railway service."

The experiment is, in fact, not an experiment in electrical traction, but in the conversion of a steam line to an electric line under practical conditions of absolute non-interruption of the existing service during the process of conversion. The man who contends that this was not worth trying upon a portion of the system, before embarking upon the whole scheme, must have a very robust contempt for the commercial side of engineering. Incidentally, many valuable traction data will be got upon this short line; data, not as the writer supposes merely of general scientific interest, but of such special value as applied to the actual working out of the details of the conversion as should, in the hands of the engineers charged with the work, result in saving, many times over, the cost of so much of this first outlay as is not permanent.

In the detailed criticism of the arrangements there is an amusing idea. "At present, the temptation to a tired platelayer to sit down on the flat top of the 500-volt working conductor, and put his feet on the track rail, may only be overcome after saddening experience." A glance at the section showing the relative positions of the conductor and the rail will show that to sit upon the conductor with the feet upon the rail would be for most men impossible, and restful for none.

It is only a small point, but the criticism which errs thus in a matter which may be checked with a foot rule, scarcely commends itself as a safe guide in wider questions of commercial policy and engineering practice.

The work now at last begun upon the Underground is the first example of the big work which lies before us: much will depend upon it, and it should be done well and cheaply, and for this reason we think the directors of the joint boards are rather to be commended for adopting a sound commercial policy, than rated for want of enterprise. "Softly, softly catchee monkey," is, we know by results, an uncommonly good maxim in war (Baden-Powell's). It is not a bad one in engineering either.

Such an article as that we are considering is uncommonly easy to write. You require simply pen, ink and paper, and irresponsibility. Only one sort is easier: seated in an armchair to make plans for Roberts in Africa, and with caustic pen and imperfect information to criticise the measures of the men at the front. Both have the same value, too, for we can quite as readily imagine Lord Roberts modifying his strategy or altering his tactics to square with amateur notions, as we can the directors of the Metropolitan and District Railways altering their policy for the scolding of our contemporary.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. THOMPSON & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

8,382. "Improvements in electric switches." T. W. MADSEN and F. W. MADSEN. Dated May 7th.

8,384. "Improvements in means for supporting overhead conductors for electrically propelled tramcars." J. HIGSON and J. HARGREAVES. Dated May 7th.

8,398. "Improvements in automatic telegraphic receiving instruments for Morse characters." L. CEREBOTANI and C. MORADELLI. Dated May 7th. (Complete.)

8,427. "Improvements in and connected with electrical presses." O. KAMMERER. Dated May 7th.

8,433. "Process for the production of electrically conductive illuminating bodies." F. DANNERT. Dated May 7th. (Complete.)

8,434. "Process for the production of electric incandescence bodies." F. DANNERT. Dated May 7th. (Complete.)

8,439. "Improvements relating to intercommunication by means of electro-mechanical type-writing or printing instruments." S. W. RICHARDSON and R. P. ELLIOTT. Dated May 8th. (Complete.)

8,449. "Improvements in transmitting power and in electric motors and generators therefor." R. KENNEDY. Dated May 8th.

8,457. "Improvements in means for electrically lighting light-ships and other stationary vessels." J. H. JUNGE. Dated May 8th. (Complete.)

8,465. "Improvements in or relating to electric motors." A. J. BOULT. (P. J. Collins, United States.) Dated May 8th. (Complete.)

8,471. "Improvements in electrical accumulators." L. RENAUD. (Date applied for under Patents, &c., Act, 1883, Section 103, December 6th, 1899, being date of application in France.) Dated May 8th. (Complete.)

8,475. "Improvements in alternating electric current motive apparatus." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. P. Steinmetz, United States.) Dated May 8th. (Complete.)

8,476. "Improvements in induction electric motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, and H. M. HOBART. Dated May 8th. (Complete.)

8,479. "Improved electrical starting switch." E. J. S. WHEATCROFT and E. B. GRAY. Dated May 8th.

8,524. "Improvements in coin-freed mechanism applicable to gas, electricity and like meters." S. SIMPSON. Dated May 8th.

8,531. "Improvements in trolleys for electrically driven tramcars, motors, and the like." J. T. PEARSON. Dated May 9th.

8,544. "Improvements in electro-magnetic mechanism." W. F. JONES. Dated May 9th.

8,558. "Improvement in electric incandescent lamps." R. B. ROXBY. Dated May 9th.

8,575. "The manufacture of an improved material for insulating electrical conductors, waterproofing fabrics, and for other purposes." F. GREENING. Dated May 9th.

8,576. "Improvements in and connected with electric lamps for lighting billiard tables." A. HEBBLETHWAITE. Dated May 9th.

8,584. "An improved system of electric traction by surface contact." G. TOSI, M. TULLIO, DE FELICE, and A. PARBONI. Dated May 9th. (Complete.)

8,586. "Improved galvanic battery." C. MARTIN. Dated May 9th. (Complete.)

8,610. "Improvements in chains for electric light fittings." H. CHESHIRE. Dated May 10th.

8,611. "Improvements in electrical apparatus." W. F. JONES. Dated May 10th.

8,642. "Improvements in means for regulating pressure in electric mains." H. W. BUTLER. Dated May 10th.

8,666. "Improvements in connection with cut in and out electric switches for accumulator systems." W. A. STEVENS and R. A. BARKER. Dated May 10th.

8,668. "Improvements in electric arc lamps." THE INTERSTATE ELECTRIC COMPANY and J. MELZER. Dated May 10th.

8,671. "Improved construction of electric switch." E. SCHULZ. Dated May 10th.

8,678. "Improvements in or relating to electrical signalling apparatus." A. U. ALCOCK. Dated May 10th.

8,682. "Improvements in apparatus for measuring electrical resistances and chiefly intended for testing the electrical resistance of rail joints in the tracks of electric railways." R. W. CONANT. (Date applied for under Patents, &c., Act, 1883, Section 103, November 13th, 1899, being date of application in United States.) Dated May 10th. (Complete.)

8,704. "An apparatus for facilitating the photometry of arc lamps and like sources of light." F. W. CARTER. Dated May 11th. (Complete.)

8,719. "Improvements in electric circuit breakers." F. W. GOLBY. (A. Beyer and R. Schönfelder, Germany). Dated May 11th.

8,727. "Improvements in telephones, ear trumpets, stethoscopes, and the like." C. F. SLATER and S. R. SLATER. Dated May 11th.

8,754. "Improvements in electric switches." M. FARKAS. Dated May 11th.

8,779. "Improvements in electric switches and fuses." J. WHITCHER, A. H. LEA, and C. H. WARREN. Dated May 12th.

8,780. "Improvements in dynamo-electric machines." E. EUGENE-BROWN. Dated May 12th.

8,781. "Improvements relating to electric cash register tills." W. SNELGROVE. Dated May 12th.

8,827. "Improvements in or connected with electrical batteries." H. W. BUTLER. Dated May 12th.

8,829. "Improved safety lock with electrical door opening device." J. SKOPEC and N. HEID. Dated 12th May. (Complete.)

8,866. "Improvements in electric signaling apparatus." P. A. NEWTON. (H. G. Carleton, United States.) Dated May 14th. (Complete.)

8,880. "Improvements relating to means for recording the number and duration of telephonic communications." H. EICHWEDE. Dated May 14th. (Complete.)

8,883. "A new and improved lock for switches, and for other purposes." W. E. EMERY. Dated May 14th.

8,894. "Improvements in electric smelting furnaces." H. KOLLER. Dated May 14th. (Complete.)

8,901. "A method of applying auxiliary electric drive to gas and other motors as used on cycles and motor vehicles." M. J. ASTLE and C. H. GUEST. Dated May 15th.

8,945. "Improvements in or relating to electric motors, particularly applicable for propelling boats." A. J. BOULT. (T. B. Hatch, United States.) Dated May 15th. (Complete.)

8,968. "Improved means for protecting electric conductors." M. J. P. O'GORMAN. Dated May 15th.

9,005. "Improvements in spacing ribs or blocks for armature cores." J. A. FOSHAG. Dated May 15th. (Complete.)

9,033. "Improvements in strap coils for electrical machines." J. P. MALLETT. (Date applied for under Patents, &c., Act 1883, Sec. 103, October 17th, 1899, being date of application in United States.) Dated May 16th.

9,058. "Improvements in electric brakes." F. C. NEWELL. Dated May 16th.

9,059. "Improvements in electric brakes." F. C. NEWELL. Dated May 16th.

9,060. "Improvements in electro-magnetic brake shoe." F. C. NEWELL. Dated May 16th.

9,061. "Improvements in automatic regulator for electric brakes." F. C. NEWELL. Dated May 16th.

9,084. "Improvements in electric arc lamps." A. G. STOCKWELL. Dated May 16th.

9,110. "Improvements in contact pieces for transmitting the current from the fixed base to the revolving or swinging top of electric search light projector." M. PAUL. (J. Paul, India.) Dated May 17th. (Complete.)

9,111. "Improvements in or relating to apparatus for maintaining in a 'taut' condition, the cord or rope employed for actuating the 'trolley-arm' employed in connection with electrically propelled cars or vehicles." H. ENGLAND. Dated May 17th.

9,133. "An improved process for manufacturing thin homogeneous plates, more particularly applicable for use in electrical condensers." L. LOMBARDI. (Date applied for under Patents, &c., Act, 1883, Sec. 103, October 30th, 1899, being date of application in Italy.) Dated May 17th. (Complete.)

9,146. "Improvements in or relating to telephone systems and installations." H. DEGENHARDT. Dated May 17th.

9,169. "Improvements in electricity meters." W. LAWSON and CHAMBERLAIN and HOOKHAM, LIMITED. Dated May 18th.

9,181. "Improvements in electrical apparatus." W. F. Jones. Dated May 18th.

9,186. "An improvement on insulator and telegraph wire fastener." W. Davies. Dated May 18th.

9,200. "An improved dynamo-electric machine and driving gear for a vehicle." F. Heimel. Dated May 18th.

9,208. "Improvements in dynamos." The Hon. C. A. Parsons and G. G. Stoney. Dated May 18th.

9,212. "Improvements in or in connection with trolley or like current collectors for electric railways and tramways." J. H. Killip. Dated May 18th.

9,229. "Method of and means or apparatus for testing alternating current generators, transformers, meters and analogous apparatus." Willans and Robinson, Limited, and G. L. Addenbrooke. Dated May 18th.

9,233. "Improvements in bayonet joint attachments for glow lamps, safety fuses, wall contacts, switches, and similar devices." M. Weinberger. Dated May 18th. (Complete.)

9,242. "Improvements in electric arc lamps." T. Thompson. Dated May 19th.

9,260. "Improvements in or relating to electric light carbons." H. S. Browne. (J. T. Sanders, United States.) Dated May 19th.

9,263. "Electric heating apparatus." A. R. Lease. Dated May 19th.

9,263. "Improvements in electric heaters." A. R. Lease. Dated May 19th.

9,273. "Improvements in or relating to telephonic connections." K. N. von Szoport. Dated May 19th.

9,279. "Improvements in and connected with supports for electric conductors." P. A. Lorain and A. Dennery. Dated May 19th.

9,281. "Improvements in galvanic batteries." R. E. Disher. Dated May 19th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

8,442. "Improvements in electric meters." W. D. Marks. Dated April 9th, 1898. Relates to quantity meters. The specification does not admit of abridgment, as the invention is described in great detail and illustrated by several sheets of drawings. 5 claims.

8,832. "Improvements in electricity meters." C. E. O. Keenan. Dated April 15th, 1898. Relates to quantity, energy and recording electrical measuring instruments. The specification does not permit abridgment as the invention is described in great detail and illustrated by several sheets of drawings. 14 claims.

10,177. "Improvements in lamp irons applicable to the suspension of electric fittings." J. B. Melklejohn. Dated May 4th, 1898. Supporting lamps from ceilings. The bent down end of a tube conveying the conductors, or a special tube supported by a flange above or on the lower surface of a ceiling, is provided with lateral openings and screw-threaded to carry a cap, which is provided with either a cord grip, a hook or a ball joint, or is used as a coupling to support the flanged tube of an electrolier. The ends of the conductors are passed through the openings and connected outside the tube. A cover is supported by a screwed ring. 1 claim.

10,236. "Improvements in electric arc lamps." W. J. L. Sandy, D. C. Bate and T. Geer. Dated May 4th, 1898. A clutch lamp is arranged in section as shown. The upper carbon passes through holes in two clutch plates which are pivoted to an arm of a sleeve and to a rod. The sleeve receives the carbon, and forms or carries the core of a series solenoid which tends to lift the sleeve, clutch and carbon. The sleeve slides as a piston in the solenoid which serves as a dash-pot. When the sleeve descends the rod is stopped by a plate and the clutch frees the carbon. The lamp may be provided with an arc-enclosing globe held against asbestos or other packing in a groove in a slate cover. The upper carbon passes through a flanged tube, which is free to slide laterally in this cover. 4 claims.

10,245. "An improved automatic electric cut-in and cut-out." A. E. R. Bottone. Dated May 5th, 1898. Relates to an automatic contact closing and opening device for dynamos controlled by the magnetism of one of the pole-pieces. A lever pivoted in a support carries a soft iron armature, a contact for completing the circuit and a spring or counterweight. The appliance is mounted on, or in proximity to, a pole-piece, and the spring is so adjusted that contact is made when the dynamo reaches the desired voltage, and is broken when it falls below the limit. The lever instead of directly making contact may operate switching mechanism or close a relay circuit controlling the main switch. In another modification the armature is carried by a sliding rod fitted with a disc adapted to engage spring contacts. 3 claims.

10,291. "Improvements in rheostats for electric circuits." C. Wirt. Dated May 5th, 1898. A continuous metal ribbon is wound or folded into a number of connected sections. These may be made by winding them on a circular or ellipitcal mandrel, and afterwards pressing them flat. The layers in each section are separated by applying an insulating cement to the ribbon as it is wound, or by oxidizing the surface of the ribbon or otherwise. The connected sections are arranged circularly on mica or asbestos insulation in a ribbed case. Each section is covered by a metal sector, and the sectors are held down by insulating material below a covering ring, which is secured in the case by screws. The inner ends of the sectors extend over a slate disc, which is supported by a spring under a brush. The brush is carried by a handle, and serves to connect any of the sectors with a ring connected with the first sector in the series. 7 claims.

10,346. "Improved apparatus for automatically cutting off current of electric overhead or other like wires." R. Bostock and F. A. Cheetham. Dated May 6th, 1898. Relates to means for cutting off the current from an overload conductor in case of breakage. A frame is fitted with a ring for attachment to a support, and carries guides of insulating material for sliding blocks. These blocks carry arms to which the hooks for the conductors are pivoted. Weighted cranked arms are connected by links to the blocks, and tend to force them back when drawn out by the tension of the conducting wires. Arms electrically connected by the wire are held by springs against the rods. Arms or shields which serve as guides for the trolley wheel are held up by pins engaging in holes in the sliding block, and may be connected by a conductor. Should a wire break, the block slides back, allowing the arms to fall apart; the conductor attached to the arm is thus entirely disconnected. 3 claims.

10,428. "Improvements in electro-therapeutic exercising apparatus." A. Martin. Dated May 6th, 1898. The apparatus described in Specification No. 27,387, A.D. 1897, is improved by gearing the shaft by means of a chain to another shaft which has a crank and connecting rod to operate a sliding carriage for the feet. When the arms are extended in turning the crank the legs are also extended, and when the body is straightened the legs are drawn up. The handle is hinged so as to be capable of turning up out of the way, a sleeve keeping it extended when required. The connections of the dynamo to the handle are made through a sleeve and a spring contact. 1 claim.

10,440. "Improved means for supporting and connecting arc lamps and other electrical apparatus." A. L. Davis. Dated May 7th, 1898. Arc lamps or other electrical apparatus are supported by cords and pulleys on ceilings or brackets, couplings being arranged to connect them electrically when raised. The apparatus is attached to the cord by a hook or otherwise. The pulley is supported in a top piece which carries a cover and two concentric tubes. These are provided with bases and binding screws, and are secured on the top pieces by insulated bolts, with intervening mica plates. The inner tube is lined with insulating material. The hook carries two insulated tubes provided with binding screws, and adapted to fit between and make connection with the tubes. The tubes may be split longitudinally. 2 claims.

10,450. "Improvements in the construction of dynamo-electric machines and motors." M. W. W. Mackie. Dated May 7th, 1898. A rotating shaft carries a cylindrical core supporting discs at its ends within pole-pieces, any number of which project from a stationary ring on opposite sides alternately. Field windings are carried between the pole-pieces and between the two masses of discs, or the pole-pieces may be wound separately. The winding is supplied with current through rings; it may be omitted. The armature consists of any kind of winding across the face of the discs and coil, or in slots in the discs, the arrangement preferred being chord winding such that any conductor is directed oppositely under successive pole-pieces. The gaps between the pole-pieces are closed by protecting plates; or the whole machine may be enclosed. The pole-pieces may taper away from the ring. The pole faces may be made with circular V grooves. The core may be recessed between the end portions, which carry the rings. It may be built up entirely of plates, each consisting of a disc with its central part pressed out in conical form, or of wires, the ends of which are bent outward between the discs. The pole ring may be rotated and the armature and core made stationary. 9 claims.

10,483. "Improvements in and relating to electrical switches." F. W. Abbot and R. W. Bill. Dated May 7th, 1898. Switches adapted for high voltage currents. The movable arm carries a crosshead fitted with contacts adapted to engage fixed contacts on the base. It is mounted on a sleeve working on a spindle, and is provided with a spring to give a quick break. The handle is carried by a rocker on the spindle, and is provided with a heel piece adapted to engage the end of the lever to break contact. The cross-head is provided with a buffer to prevent jarring, and is insulated from the switching mechanism by insulating washers. 2 claims.

10,496. "A new or improved maximum electric current self-recording instrument." F. M. Staunton. Dated May 7th, 1898. Relates to current meters. A base carries bearings, and a fixed semi-circular solenoid, conveying the current to be measured, or a known part of it. The solenoid attracts a curved iron core, carried by an arm of a shaft rotatable on the bearings in opposition to a counter-weight or a spring. The shaft carries also a graduated circle and a glass tube which may be a closed ring or have open ends, and which contains some mercury and a movable index. When the core is attracted more or less into the solenoid, the tube and circle turn so that the mercury flows past a contraction in the tube, and moves the index to a corresponding position, where it remains until it is returned by a magnet or otherwise. 3 claims.

10,511. "Improvements in and apparatus for producing mechanical energy from alternating electric currents." A. Heyland. Dated May 7th, 1898. Induction motors for single or multiphase alternating currents have their inducing windings arranged to facilitate economical starting. These windings are divided into sections which are connected in parallel when the motor is running at its proper speed, but at starting only, those sections which are adjacent in different windings are supplied with current. A single phase motor having its ordinary inducing winding in three sections connected by a switch to supply mains so that on starting the section only is supplied with current is described. Adjacent to this section is the angularly placed winding which on starting is supplied with current in different phase through a switch and a condenser, or an inductance coil or a transformer. As the speed increases, the windings are successively connected. The armature may be connected with three adjustable resistances. A two-phase motor may be constructed similarly, the winding switch and condenser being replaced by a divided winding and a second switch in the second circuit. The sections which are first connected in circuit may be wound with thinner wire than the others. 13 claims.

10,616. "Improvements in enclosed arc lamps." G. Thomas-Davies. Dated May 7th, 1898. Arc lamps are constructed to use carbons side by side and nearly parallel, the carbons and holders being situated in globes which are closed except where shafts carrying the holders turn in bearings formed in the metal tops of the globes. Otherwise the globe may be closed entirely, the carbon holders carrying armatures which are acted on, through a thin porcelain or like plate covering the globe, by an external electro-magnet, movement of the armatures being opposed by springs. In either constructions the arc is kept at the ends of the carbons by a magnetic field existing between the convergent limbs of a long horse-shoe magnet. Two projections on this magnet maintain a stronger field near the carbon holders to protect these. Each carbon holder may carry two or more carbon rods held together side by side so that the arc passes to which ever carbon is longest. One carbon holder is fixed on the base plate, the other is carried by a horizontal shaft which passes through bearings in a cup and carries arms supporting the cores of flat series and shunt solenoids, a balance weight and adjustment weight and a dash-pot. The piston of this is carried by a counter-weighted link on a fixed bracket. The magnet is wound in series with the carbons. In a modified arrangement both carbon holders are supported by horizontal shafts, arms of which are linked to a large dash-pot movable vertically on a stationary piston by the U-shaped core of two vertical solenoids; the dash-pot, &c., are supported by two springs. In a different construction, one carbon is slightly inclined in a holder which forms an arm of a vertical shaft; this passes through a bearing in the top plate of the globe, and has a curved arm carrying a U-shaped core in horizontal shunt solenoids, which tend to turn the shaft in opposition to a spring, and so to bring the carbons together. The globe has a flange clamped between two rings. One ring is bored to fit a conical surface on the plate of the lamp, and is held against this surface by springs and eye-bolts which engage lugs on the other ring. The springs permit escape of gas between the conical surfaces if the pressure in the globe becomes too great. In another arrangement, the globe-holding rings are screwed upon the base-plate of the lamp, a flange on which enters a packed groove in the upper ring; perforations in the cups on the base-plate are normally closed by the spring-pressed lift-valves. 4 claims.

14,810. "Improvements in electric couplings." W. J. Davy. Dated July 5th, 1898. Couplings for arc lamps which have to be raised and lowered. Conical contact rings are mounted on an insulating base seated on a dished guide, which is forced outwards by a spring against a stop ring. The movable contact rings are mounted on a base seated on the cap of the lamp. The hauling rope is fixed to the cap and passes through the hood as shown. 3 claims.

14,826. "Improvements relating to collectors for electric railways." R. Belfield. (The Westinghouse Electric and Manufacturing Company.) Dated July 5th, 1898. Relates to electric railways and tramways with overhead conductors. The head of the collector has a roller at the centre and arms protected by wearing-pieces at each side. These arms are curved at the ends to prevent entanglement with the overhead conductors, and are supported from the pole by the return ends. The roller, &c., is mounted in a spring steel riveted frame, or a cast frame and the roller is made with graphite bearings. The pole is a plain single pole, or trussed, or it may be double. At its lower end it is pivoted on a boom which swivels on a plate on the top of the car, being additionally supported by a roller. A pivoted arm on the boom makes contact with a plate to complete the circuit when the appliance is correctly placed in its fore and aft position, and there locked by a blot. The pole is held up to its work by a spring surrounding it or the boom or contained in the boom, several modifications being described in the specification. When the spring surrounds the pole it works within limits allowed by stop rods. The cord for manipulating the collector is continued to a lever which operates the spring locking bolt. In a modification the spring surrounds the boom and acts through rods connected to arms on the pole socket, and a button on the cord liberates the bolt when the pole is drawn down to a certain extent. Other modifications in the details are also included. 7 claims.